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GUIDELINES FOR USING OZIPM-3 WITH CBM-X OR OPTIONAL MECHANISMS

Volume 2.

Computer Code

by

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16. ABSTRACT

A computer program, called Ozone Isopleth Plotting with Optional Mechanisms/Version 3 (OZIPM-3), has been developed. The program enables the use of a new Carbon Bond Mechanism (CBM-X) for EKMA control strategy calculations. The OZIPM-3 program also has the capability to accept a chemical mechanism other than the default CBM-X that is internally stored in the program. Volume 1 serves as the User's Manual for OZIPM-3. It contains a detailed description of how OZIPM-3 operates. It also contains a thorough discussion of the different input and output options available to the user when exercising either the default CBM-X mechanism or an optional mechanism. Five examples of OZIPM-3 simulations are presented. Input and output files for each example are included. Volume 2 contains the FORTRAN listing of the computer code. A magnetic tape of this code is also available.

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ABSTRACT

The U.S. Environmental Protection Agency is continuing to recommend the use of the Empirical Kinetic Modeling Approach (EKMA) as a procedure for relating levels of photochemical ozone to levels of organic compounds and oxides of nitrogen. In a recent study, Systems Applications developed a new chemical mechanism that is suitable for use in EKMA. The mechanism, called the extended Carbon-Bond Mechanism (CBM-X), provides the most up-to-date and verified description of urban smog chemistry currently available. In the study reported here, a new computer program called Ozone Isopleth Plotting with Optional Mechanisms--Version 3 (OZIPM-3) was developed to enable the use of the CBM-X mechanism for EKMA control strategy calculations. The OZIPM-3 program can also use a chemical mechanism other than the default CBM-X that is internally stored in the program. Volume 1 serves as the User's Manual for OZIPM-3. It contains both a detailed description of how OZIPM-3 operates and a thorough discussion of the different input and output options available to the user when exercising either the default CBM-X mechanism or an optional mechanism. Five examples of OZIPM-3 simulations and input and output files for each example are included. Volume 2 contains the FORTRAN listing of the computer code. A magnetic tape of this code is also available. OZIPM-3 expands on earlier codes by providing a wider compatibility between computers, a feature that allows calculation of control strategies without drawing an isopleth diagram, and easier input for photolysis rates when optional chemical mechanisms are used.

```
C     PROGRAM MAIN
C
C***********************************************************************
C
C
C                           OZIPM-VERSION 3.1
C
C       THE OZONE ISOPLETH PLOTTING PACKAGE WITH OPTIONAL CHEMICAL
C   MECHANISM (VERSION 3.1) IS USED IN THE EMPIRICAL KINETICS
C   MODELING APPROACH (EKMA) TO ESTIMATE VOC CONTROL REQUIREMENTS
C
C       THIS VERSION CONTAINS THE EXTENDED CARBON-BOND CHEMICAL
C   MECHANISM (CBM-X) DESCRIBED BY WHITTEN, KILLUS AND JOHNSON (1985)
C   (EPA-600/3-85-025)
C
C   DESCRIPTIONS OF MODEL USAGE ARE PROVIDED BY
C   HOGO AND WHITTEN (1985)
C
C            CODE WRITTEN BY:
C
C                     H. HOGO
C                     G. Z. WHITTEN
C                     R. G. JOHNSON
C
C                     SYSTEMS APPLICATIONS, INC
C                     101 LUCAS VALLEY RD
C                     SAN RAFAEL, CA 94903
C                     (415) 472-4011
C
C***********************************************************************
C
      COMMON /CALC/ NR,KR(200,12),A(200),S(200),R(200),ITYPE(200),IA(90)
     1,JA(1500),DILUT,TEMP,ERR,START,STOPP,SPECIS(91),TPRNT,TSTEP,ZENI
      COMMON /CNTRL/ SIG,SIGMA,INFO,NPTO,TSRT,DTIM,Z1,Z2,DCON,EHC,EXN,FL
     1ST,TLST
      COMMON /OPTS/ ISPD,ICAL,IACR,IDIL,IPLC,IEMS,IRDY,IBLK,IBCK,
     1IPLT,ITRN,ITIT,IRCT,IRAT,ITIM,IMCH,INIT,ISTR,IMIX,ISPC,ITMP
     2,IALF,IDEP,IZNI,IMAS,IMOL
      COMMON /SPEC/ NS,HCSPEC(15),CARB(15),RCTY(15),XNF(2),IH(15),
     1INOX(2),FINHC(15),FALHC(15),NHC,OZIN,OZAL,HCIN,HCAL,XNIN,XNAL,
     2NOZ,FENX(2),C(91),REACT(91),NI,PLSP(5),KOZ(5)
      COMMON /SUNLIT/ Z(10),RTCON(10),
     1LAM1,INC,SLA,SLO,TZ,IY,IM,ID,ISTRT,ISTOP,IINC,IEND,SPECIE,MAXZ,ITI
     2ME(24),XZ(24),KKK(24),JSTRT,JSTOP,PSPEC,MNLM,MXLM,MAXL,MAXJ
      COMMON /PHOTON/ CF(72,20),P(24,20),IPH(20),IP,RFCT(20),PP(10,20)
      COMMON /ZENITH/ IPZ,ZDEF(10,20),IPHZ(20),IZENP
      COMMON /EMIS/ NEM,ISP,ESTRT(5),ESTOP,ESLP,EMSP(5),IEMLS(5),EOSLP(5
     1),EMO(26,5),ECI(5),EM(26),EC(125),ECO(125,5)
      COMMON /MIX/ NMIX,AMIX(26),STRM,STOPM,DC(104)
      COMMON /MIXING/ DSTRT,DEND,AMC(5),BMC(5),CMC(5),FD(6),FG(6),
     1 AMXX(26),DL,TTMAX,SSRISE,SRMIN,DELH,TDIL,NMXX,HEIGHT,SSET,SRISE
      COMMON /TEMPER/ TEMEND,NTEMP,QM(30)
      COMMON /FRPLOT/ SAVCON(80,5),SAVTIM(80),NTSV,INOW
      COMMON /INOUT/ IN,IOUT,ITAPE,IALN,IALL,INHH
      COMMON /TITL/ ITTL(36)
      COMMON /NEED/ HC,XN,NL,NRTO,RTO(20),OZP(20),OZN(8,20),RHO(8,20),MR
     1,OC(4),OS(2),HCS,XNS,LS,HCLL(8),XNLL(8)
      COMMON /HEAT/ SC(200,12),ISC(200,3)
      COMMON /NEED1/ IBLANK,MBLANK,IIHC,IINX,IICO,IINO2,IINO,II03,
     1IIH2O,IBZA,JPLUS
      COMMON /STORE/ AST(60)
      COMMON /HOUR/ OZM(5),NGO,TTM,TM(5)
      COMMON /PLTVEC/ HCT(20),OT(20),NT,OHC,HCG,PLTGRD,OXN,XNG,HC1,XN1,T
     1ICZ,DIGZ,CHRZ
      COMMON /ALOFT/ IALFT,CALFT(10),LOCALF(10),ISPAL(10)
      COMMON /DEPOS/ IDEPO,RDEPO(26,10),LOCDEP(10),ISPDP(10),RDCOEF(125,
     110),IDPTIM,DPEND,RDEP1(26,10),DNOWS
      COMMON /VVLB1/ FCTR,DIST,CHRSIZ,NNCHR,OZBL
      COMMON /BK1/ FBK(10),FBKAL(5),HCBK,XNBK,OZBK
      DIMENSION F(21), X(7), IPLACE(6), ITMIX(26), IZC(10)
      DIMENSION NRTC(100), XRTC(100),OZAR(4)
      INTEGER SPECIS,HCSPEC,PLSP,PSPEC,EMSP,JTTL(36)
C
C  INITIALIZE SOME LOCAL VARIABLES
C
      DATA HCCON/595./,XNXCON/1890./,F(21)/0.0/,ITEST/2HZO /
      DATA IPLACE/4H LOS,4H ANG,4HELES,4H, CA,4HLIF.,4H    /
      DATA IEM,KALCMP,JS,KS1/4*0/,NC/11/
      DATA IZC/0,10,20,30,40,50,60,70,78,86/
      DATA JTTL /2H  ,2H I,2HSO,2HPL,2HET,2HH ,30*2H  /
C
C     CALL DATA INITIALIZATION ROUTINES
C
      WRITE (IOUT,289)
      CALL MECH
      CALL PHOT (IPLACE)
      CALL MIXST
      CALL SUNTIM
C
C  READ INPUT FILE AND PRINT IT
C
C **** NOTE THE FOLLOWING CODE IS NOT NEEDED IN ORDER TO USE
C      OZIPM-3.  IF THE USER FINDS THAT THE INPUT FILE (DEFAULT
C      UNIT 5) CANNOT BE REWOUND USING  REWIND  STATEMENT THEN
C      EITHER THE INPUT UNIT NUMBER NEEDS TO BE CHANGED OR
C      THE FOLLOWING SECTION OF CODE CAN BE COMMENTED OUT.
C
      WRITE (IOUT,490)
      DO 1 I=1,1000
      READ (IN,295) ITTL
      DO 111 IJ=1,20
      IF (ITTL(IJ).NE.IBLK) GO TO 112
  111 CONTINUE
      GO TO 2
  112 IF(MOD(I,50).EQ.0) WRITE (IOUT,490)
      WRITE (IOUT,296) ITTL
    1 CONTINUE
    2 CONTINUE
      REWIND IN
C
C OPTIONS LOOP
C
    5 READ(IN,290) IOPT,(X(I),I=1,6)
C
C  DO ISOPLETH
C
      IF (IOPT.NE.ISPD) GO TO 20
      IF (ABS(X(1)).NE.0.) HC=X(1)
      IF (ABS(X(2)).NE.0.) XN=X(2)
      IF (ABS(X(4)).NE.0.) INFO=-1
      IF (ABS(X(3)).NE.0.) NL=IFIX(X(3)+0.1)
      IF (ABS(X(3)).NE.0.) READ(IN,300) (OZP(I),I=1,NL)
      IF (ABS(X(5)).NE.0.) FCTR=X(5)
      CALL HDWRIT(IPLACE,IEM)
C
C  PERFORM DIAGRAM CALCULATIONS
C
      CALL RLINE (NC,F,KS1,JS)
      CALL LINER (SIG,KALCMP,F)
      INFO=0
      GO TO 5
C
C  DO INDIVIDUAL CALCULATIONS
C
   20 IF (IOPT.NE.ICAL) GO TO 35
      NPTO=1
      IF (ABS(X(3)).NE.0.) INFO=1
      TPRNT=60.
      TSTEP=60.
      IF (ABS(X(4)).NE.0.) TPRNT=X(4)
      IF (ABS(X(5)).NE.0.) TSTEP=X(5)
      NTSV=0
      CALL HDWRIT(IPLACE,IEM)
      CALL SIM (X(1),X(2),ZN,1)
      IF (INFO.EQ.1) WRITE (IOUT,297)
      DO 38 I=1,NOZ
      IF (TM(I).GT.0.) TMX=CLOCK(FLOAT(JSTRT),IFIX(TM(I)))
      IF (TM(I).GT.0.) WRITE (IOUT,310) PLSP(I),OZM(I),TMX
      IF (TM(I).LE.0.) WRITE (IOUT,335) PLSP(I),OZM(I)
   38 CONTINUE
```

```
      CALL SPLOT
      NPTO=0
      INFO=0
      GO TO 5
C
C  IMPLEMENT ACCURACY OPTION
C
   35 IF (IOPT.NE.IACR) GO TO 40
      IF (ABS(X(1)).NE.0.) NC=IFIX(X(1)+0.1)
      IF ((NC/2).EQ.((NC+1)/2)) NC=NC+1
      IF (ABS(X(2)).NE.0.) MR=IFIX(X(2)+0.1)
      IF (ABS(X(3)).NE.0.) ERR=X(3)
      IF (ABS(X(4)).NE.0.) SIG=X(4)
      IF (ABS(X(5)).NE.0.) SIGMA=X(5)
      IF (ABS(X(6)).NE.0.) NGO=0
      GO TO 5
C
C  READ PLACE OPTION
C
   40 IF (IOPT.NE.IPLC) GO TO 45
      IF (ABS(X(1)).NE.0.) SLA=X(1)
      IF (ABS(X(2)).NE.0.) SLO=X(2)
      IF (ABS(X(3)).NE.0.) TZ=X(3)
      IF (ABS(X(4)).NE.0.) IY=IFIX(X(4)+0.01)
      IF (ABS(X(5)).NE.0.) IM=IFIX(X(5)+0.01)
      IF (ABS(X(6)).NE.0.) ID=IFIX(X(6)+0.01)
      IF(ABS(X(1)).NE.0..OR.ABS(X(2)).NE.0.)READ(IN,330)(IPLACE(I),I=1,6
     1)
      CALL PHOT (IPLACE)
      CALL MIXST
      CALL SUNTIM
      GO TO 5
C
C  READ MORNING AND AFTERNOON MIXING HEIGHTS
C
   45 IF (IOPT.NE.IDIL) GO TO 50
      IF (ABS(X(1)).NE.0.) Z1=X(1)
      IF (ABS(X(2)).NE.0.) Z2=X(2)
      IF (ABS(X(3)).NE.0.) DSTRT=X(3)
      IF (ABS(X(4)).NE.0.) DEND=X(4)
      AMIX(1)=-3.
      CALL MIXST
      CALL SUNTIM
      JMIN=IFIX(DSTRT)-((IFIX(DSTRT)/100)*100)
      TMIN1=FLOAT((IFIX(DSTRT)/100)*60+JMIN)
      JMIN=IFIX(DEND)-((IFIX(DEND)/100)*100)
      TMIN2=FLOAT((IFIX(DEND)/100)*60+JMIN)
      JMIN=JSTRT-((JSTRT/100)*100)
      TMIN3=FLOAT((JSTRT/100)*60+JMIN)
      TMIN4=AMAX1(TMIN1,TMIN3,SSRISE)
      TSRT=TMIN4-TMIN3
      IF (TSRT.GT.0.) DTIM=TMIN2-TMIN4
      IF (TSRT.LE.0.) DTIM=TMIN2-TMIN3
      IF (DTIM.LT.0.) DTIM=0.
      DCON=ABS(X(5))
      GO TO 5
C
C  READ HOURLY MIXING HEIGHTS
C
   50 IF (IOPT.NE.IMIX) GO TO 56
      NMIX=IFIX(X(1)+0.1)+1
      DO 55 I=1,5
   55 AMIX(I)=X(I+1)
      IF (NMIX-5.GT.0) READ(IN,300) (AMIX(I),I=6,NMIX)
      CALL MIXSET
      DTIM=STOPM
      TSRT=0.
      GO TO 5
C
C  READ HOURLY TEMPERATURE DATA
C
   56 IF (IOPT.NE.ITMP) GO TO 60
      NTEMP=IFIX(X(1)+0.1)+1
      DO 57 I=1,5
   57 QM(I)=X(I+1)
      IF (NTEMP-5.GT.0) READ(IN,300) (QM(I),I=6,NTEMP)
      QM(NTEMP+1)=2.*QM(NTEMP)-QM(NTEMP-1)
      QM(NTEMP+2)=3.*QM(NTEMP)-2.*QM(NTEMP-1)
      TEMEND=FLOAT(NTEMP-1)*60.
      TEMP=QM(1)
      GO TO 5
C
C  READ EMISSIONS
C
   60 IF (IOPT.NE.IEMS) GO TO 69
      NEM=IFIX(X(1)+0.1)
      IEM=IFIX(ABS(X(1))+0.1)
      ESTOP=FLOAT(IEM)*60.
      IF (X(1).LT.(-0.99999999)) GO TO 62
      DO 63 I=1,5
   63 EM(I)=ABS(X(I+1))
      IF (NEM-5.GT.0) READ(IN,300) (EM(I),I=6,NEM)
      CALL EMISS (NEM,EM,EC)
      ISP=2
      EMSP(1)=IIHC
      EMSP(2)=IINX
      GO TO 5
   62 DO 64 I=1,5
   64 EMO(I,1)=X(I+1)
      IF (EMO(1,1).LT.(-0.0001)) GO TO 66
      ISP=1
      EMSP(1)=IIHC
      IF (IEM-5.GT.0) READ(IN,300) (EMO(I,1),I=6,IEM)
      CALL EMISS (IEM,EMO(1,1),ECO(1,1))
   66 READ(IN,300) (EMO(I,2),I=1,7)
      IF (EMO(1,2).LT.(-0.0001)) GO TO 5
      ISP=2
      EMSP(2)=IINX
      IF (IEM-7.GT.0) READ(IN,300) (EMO(I,2),I=8,IEM)
      CALL EMISS (IEM,EMO(1,2),ECO(1,2))
      GO TO 5
C
C    READ EMISSIONS (MOLAR UNITS OR PPM UNITS)
C
   69 IF (IOPT.NE.IMOL) GO TO 85
      NEM=IFIX(X(1)+0.1)
      IEM=IFIX(ABS(X(1))+0.1)
      ESTOP=FLOAT(IEM)*60.
      IF (X(1).LT.(-0.99999999)) GO TO 70
      DO 65 I=1,5
   65 EM(I)=ABS(X(I+1))
      IF (NEM-5.GT.0) READ(IN,300) (EM(I),I=6,NEM)
      CALL EMISS (NEM,EM,EC)
      GO TO 5
   70 ISP=IFIX(ABS(X(2))+0.1)
      FHT=X(3)
      DAREA=X(4)
      HCEM=X(5)
      XNEM=X(6)
      EFACT=0.
      IF (FHT.GT.0.) EFACT=24450./FHT
      IF (FHT.GT.0..AND.DAREA.GT.0.) EFACT=24450./(FHT*DAREA)
      DO 37 I=1,ISP
      READ (IN,290) EMSP(I),(EMO(J,I),J=1,6)
      IF (IEM-6.GT.0) READ (IN,300) (EMO(J,I),J=7,IEM)
      IF (FHT.LE.0..OR.DAREA.LE.0.) GO TO 73
      IF (EMSP(I).NE.IIHC.AND.EMSP(I).NE.IINX) GO TO 72
      CONCEN=HCEM
      IF (EMSP(I).EQ.IINX) CONCEN=XNEM
      CONV=HCCON
      IF (EMSP(I).EQ.IINX) CONV=XNXCON
      Q0=1./(CONV*CONCEN*FHT)
      DO 71 J=1,IEM
      EMO(J,I)=EMO(J,I)*Q0
   71 CONTINUE
      GO TO 73
C
C    CONVERT OTHER SPECIES
C
   72 CONTINUE
```

```
      DO 74 J=1,IEM
      EMO(J,I)=EMO(J,I)*EFACT
   74 CONTINUE
   73 CALL EMISS (IEM,EMO(1,I),ECO(1,I))
   37 CONTINUE
      GO TO 5
C
C  READ EMISSIONS (MASS UNITS)
C  THIS OPTION WAS IMPLEMENTED IN OZIPM-2
C
   85 IF (IOPT.NE.IMAS) GO TO 89
      NEM=IFIX(X(1)+0.1)
      IEM=IFIX(ABS(X(1))+0.1)
      ESTOP=FLOAT(IEM)*60.
      ISP=2
      EMSP(1)=IIHC
      EMSP(2)=IINX
      READ (IN,300) (EMO(I,1),I=1,IEM)
      READ (IN,300) (EMO(I,2),I=1,IEM)
      HCEM=X(2)
      XNEM=X(3)
      FHT=X(4)*.001
      DO 88 I=1,ISP
      CONCEN=HCEM
      IF (EMSP(I).EQ.IINX) CONCEN=XNEM
      CONV=HCCON
      IF (EMSP(I).EQ.IINX) CONV=XNXCON
      Q0=1./(CONV*CONCEN*FHT)
      DO 87 J=1,IEM
      EMO(J,I)=EMO(J,I)*Q0
   87 CONTINUE
      CALL EMISS (IEM,EMO(1,I),ECO(1,I))
   88 CONTINUE
      GO TO 5
C
C
C  READ CALCOMP PLOTTING OPTION
C
   89 IF (IOPT.NE.IPLT) GO TO 90
      KALCMP=1
      FCTR=0.6
      HC1=8.5
      XN1=5.95
      CHRZ=0.10
      IF (ABS(X(1)).NE.0.) FCTR=X(1)
      PLTGRD=X(2)
      IF (ABS(X(3)).NE.0.) HC1=X(3)
      IF (ABS(X(4)).NE.0.) XN1=X(4)
      IF (ABS(X(5)).NE.0.) CHRZ=X(5)
      IF (ABS(X(6)).NE.0.) CHRSIZ=X(6)
      DIGZ=CHRZ
      TICZ=CHRSIZ
      GO TO 5
C
C  PERFORM VOC CONTROL REQUIREMENT ESTIMATIONS BASED ON
C    CITY-SPECIFIC EKMA GUIDELINES
C
   90 IF (IOPT.NE.ISTR) GO TO 135
C
C  ALL EKMA CALCULATIONS ARE DONE IN SUBROUTINE EKCALC
C
      CALL HDWRIT(IPLACE,IEM)
C
C  CALL EKMA SUBROUTINE TO CALCULATE VOC CONTROL REQUIREMENTS
C
      CALL EKCALC (X)
      GO TO 5
C
C  READ REACTIVITIES
C
  135 IF (IOPT.NE.IRCT) GO TO 140
      KHC=IFIX(X(1)+0.1)
      IF (ABS(X(2)).NE.0.) XNF(1)=X(2)
      IF (ABS(X(2)).NE.0.) XNF(2)=1.-X(2)
      IF (KHC.GT.0) READ(IN,300) (RCTY(I),I=1,KHC)
      GO TO 5
C
C  READ SPECIES OF INTEREST
C
  140 IF (IOPT.NE.ISPC) GO TO 160
      IF (ABS(X(1)).GT.0.) NOZ=IFIX(X(1)+0.1)
      READ(IN,385) (PLSP(I),I=1,NOZ)
      DO 146 J=1,NOZ
      DO 145 I=1,NS
      IF (SPECIS(I).NE.PLSP(J)) GO TO 145
      KOZ(J)=I
      GO TO 146
  145 CONTINUE
      WRITE (IOUT,440) PLSP(J)
      STOP
  146 CONTINUE
  150 IF (PLSP(1).EQ.IIO3 ) GO TO 5
      IF (ITTL(6).NE.ITEST ) GO TO 5
      DO 155 I=1,36
  155 ITTL(I)=JTTL(I)
      GO TO 5
C
C  READ TITLE
C
  160 IF (IOPT.NE.ITIT) GO TO 165
```

```
      READ(IN,295) (ITTL(I),I=1,36)
      GO TO 5
C
C  READ TRANSPORT OPTIONS
C
  165 IF (IOPT.NE.ITRN) GO TO 171
      OZIN=X(1)
      OZAL=X(2)
      HCIN=X(3)
      HCAL=X(4)
      XNIN=X(5)
      XNAL=X(6)
      IF (HCIN.GT.(-0.0000001)) GO TO 170
      JIN=IFIX(ABS(HCIN)+0.1)
      READ(IN,300) HCIN,(FINHC(I),I=1,JIN)
  170 IF (HCAL.GT.(-0.0000001)) GO TO 5
      JAL=IFIX(ABS(HCAL)+0.1)
      READ(IN,300) HCAL,(FALHC(I),I=1,JAL)
      GO TO 5
C
C  READ BACKGROUND CONDITIONS
C
  171 IF (IOPT.NE.IBCK) GO TO 172
      OZBK=X(1)
      HCBK=X(2)
      XNBK=X(3)
      IF (HCBK.GE.(-0.00001)) GO TO 5
      JBK=IFIX(ABS(X(2))+0.01)
      READ (IN,300) HCBK,(FBK(I),I=1,JBK)
      GO TO 5
C
C  READ ALOFT CONCENTRATIONS OF SPECIES OTHER THAN O3,NMOC,NOX
C
  172 IF (IOPT.NE.IALF) GO TO 175
      IALFT=IFIX(ABS(X(1))+0.01)
      READ (IN,385) (ISPAL(I),I=1,IALFT)
      DO 174 I=1,IALFT
      DO 173 J=1,NS
      IF (ISPAL(I).NE.SPECIS(J)) GO TO 173
      LOCALF(I)=J
      GO TO 174
  173 CONTINUE
  174 CONTINUE
      READ (IN,300) (CALFT(I),I=1,IALFT)
      GO TO 5
C
C  READ INITIAL CONDITIONS FOR ALL SPECIES OTHER THAN O3,NMOC,NOX
C
  175 IF (IOPT.NE.INIT) GO TO 176
      NI=IFIX(ABS(X(1))+0.1)
      READ(IN,385) (REACT(I),I=1,NI)
      READ(IN,300) (C(I),I=1,NI)
      GO TO 5
C
C  READ SURFACE DEPOSITION RATE (CM/SEC)
C
  176 IF (IOPT.NE.IDEP) GO TO 180
      IDPTIM=IFIX(ABS(X(1))+0.01)
      IDEPO=IFIX(ABS(X(2))+0.01)
      DPEND=FLOAT(IDPTIM)*60.
      DO 179 I=1,IDEPO
      READ (IN,290) ISPDP(I),(RDEP1(J,I),J=1,6)
      IF (IDPTIM-6.GT.0) READ (IN,300) (RDEP1(J,I),J=7,IDPTIM)
      DO 177 J=1,IDPTIM
      RDEPO(J,I)=RDEP1(J,I)*36.
  177 CONTINUE
      CALL EMISS(IDPTIM,RDEPO(1,I),RDCOEF(1,I))
      IF (ISPDP(I).EQ.IIHC) GO TO 179
      DO 178 J=1,NS
      IF (ISPDP(I).NE.SPECIS(J)) GO TO 178
      LOCDEP(I)=J
      GO TO 179
  178 CONTINUE
  179 CONTINUE
      GO TO 5
C
C  READ ALREADY COMPLETED SIMULATIONS
C
  180 IF (IOPT.NE.IRDY) GO TO 220
      KS1=IFIX(ABS(X(1))+0.1)
      KK=0
      JS=1
      IF (KK.EQ.KS1) GO TO 5
      WRITE (IOUT,320) PLSP(1)
      DO 185 I=1,4
      IF (X(1).GT.0.) READ(IN,300) HCC,XNN,OC(I)
      IF (X(1).LT.(-0.98)) READ (IALL,1000) HCC,XNN,OC(I),OZAR
      WRITE (IALN,1000) HCC,XNN,OC(I),OZAR
      IF (XNN.NE.0.0) RTO1=HCC/XNN
      IF (XNN.EQ.0.0) RTO1=0.00000
      WRITE (IOUT,325) HCC,XNN,RTO1,OC(I)
      KK=KK+1
      IF (I.EQ.2) HCLL(MR)=XNN
      IF (I.NE.3) GO TO 184
      RTO(1)=RTO1
      F(1)=SQRT(RTO1*RTO1+1.)
      RHO(MR,1)=F(1)*XNN
      OZN(MR,1)=OC(3)
      HCE=0.98*HCC
      NCE=1
  184 IF (KK.EQ.KS1) GO TO 5
  185 CONTINUE
      IF (NC.EQ.1) GO TO 200
  190 DO 195 I=1,2
      HCS=HCC
      IF (X(1).GT.0.) READ(IN,300) HCC,XNS,OS(I)
      IF (X(1).LT.(-0.98)) READ (IALL,1000) HCC,XNS,OS(I),OZAR
      WRITE (IALN,1000) HCC,XNS,OS(I),OZAR
      RTO2=HCC/XNS
      WRITE (IOUT,325) HCC,XNS,RTO2,OS(I)
      KK=KK+1
      IF (KK.EQ.5) HCG=HCC
      IF (KK.EQ.5) OHC=OS(I)
      IF (KK.EQ.6) XNG=XNS
      IF (KK.EQ.6) OXN=OS(I)
      IF (KK.EQ.KS1) GO TO 5
  195 CONTINUE
  200 JK=MR-1
      NCR=(NC+1)/2
      DO 215 I=1,NC
      IF (JK+I.EQ.1) GO TO 215
  205 IF (X(1).GT.0.) READ(IN,300) HCC,XNN,ZN
      IF (X(1).LT.(-0.98)) READ (IALL,1000) HCC,XNN,ZN,OZAR
      WRITE (IALN,1000) HCC,XNN,ZN,OZAR
      IF (HCC.GT.HCE) NCE=NCE+1
      IF (JK.EQ.MR.AND.XNN.GT.0.) RTO(I)=HCC/XNN
      IF (JK.EQ.MR.AND.XNN.LE.0.) RTO(I)=HCC*1.0E7
      IF (JK.EQ.MR) F(I)=SQRT(RTO(I)*RTO(I)+1.)
      WRITE (IOUT,325) HCC,XNN,RTO(I),ZN
      IF (JK.LT.MR) GO TO 210
      IF (RTO(I).GT.1.02*RTO2.OR.RTO(I).LT.0.98*RTO2) GO TO 210
      RHO(MR,I)=SQRT(HCE*HCE*1.041232+XNS*XNS)
      OZN(MR,I)=OS(2)
      JK=MR-1
      NCE=NCE+1
      JS=JS+1
  210 OZN(JK,I)=ZN
      RHO(JK,I)=SQRT(HCC*HCC+XNN*XNN)
      IF (HCC.LE.0..AND.I.EQ.NCR) HCLL(JK)=XNN
      IF (XNN.LE.1.0E-7.AND.I.EQ.NC) XNLL(JK)=HCC
      KK=KK+1
      IF (KK.EQ.KS1) GO TO 5
      JK=JK-1
      IF (JK.GT.0) GO TO 205
      IF (NCE.EQ.(NC+1)/2) GO TO 190
  215 JK=MR
      GO TO 190
C
C  READ CHEMICAL MECHANISM
C
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  220 IF (IOPT.NE.IMCH) GO TO 255
      IZENP=1
      IF (X(1).LE.0.) CALL MCHWRT
      IF (X(1).LT.0.) GO TO 5
      NX=IFIX(ABS(X(1))+0.1)
      IP=IFIX(ABS(X(2))+0.1)
      NHC=IFIX(ABS(X(3))+0.1)
      NEPA=IFIX(ABS(X(4))+0.1)
      IF (ABS(X(5)).NE.0.) TEMP=X(5)
      IF (QM(1).GT.0.) TEMP=QM(1)
      IF (IP.NE.0) READ(IN,300) (XRTC(I),I=1,IP)
      IF (IP.EQ.0) GO TO 230
      DO 225 I=1,IP
  225 IPH(I)=IFIX(XRTC(I)+0.1)
C
C  PLACE ZENITH ANGLE DEPENDENCE INTO APPROPRIATE SLOT FOR EACH REACTION
C
      DO 229 K=1,IP
      DO 228 I=1,10
      PP(I,K)=1.
  228 CONTINUE
  229 CONTINUE
  230 IF (NHC.NE.0) READ(IN,385) (HCSPEC(I),I=1,NHC)
      IF (NHC.NE.0) READ(IN,300) (CARB(I),I=1,NHC)
      CALL MCHSET (NX,NEPA)
      DO 250 J=1,NS
      DO 235 I=1,NHC
      IF (SPECIS(J).NE.HCSPEC(I)) GO TO 235
      IH(I)=J
      GO TO 250
  235 CONTINUE
  245 IF (SPECIS(J).EQ.IINO2 ) INOX(1)=J
      IF (SPECIS(J).EQ.IINO  ) INOX(2)=J
      DO 246 K=1,NOZ
  246 IF (SPECIS(J).EQ.PLSP(K)) KOZ(K)=J
  250 CONTINUE
      INHH=1
      GO TO 5
C
C  MODIFY RATE CONSTANTS USING THE RATE OPTION
C
  255 IF (IOPT.NE.IRAT) GO TO 280
      NRR=IFIX(X(1)+.1)
      IF (ABS(X(2)).NE.0.) GO TO 270
      READ(IN,300) (XRTC(I),I=1,NRR)
      DO 260 I=1,NRR
  260 NRTC(I)=IFIX(XRTC(I)+.1)
      READ(IN,300) (XRTC(I),I=1,NRR)
      DO 265 I=1,NRR
      J=NRTC(I)
      DO 266 JK=1,IP
      IF (J.EQ.IPH(JK)) RFCT(JK)=XRTC(I)
      IF (J.EQ.IPH(JK)) GO TO 267
  266 CONTINUE
  267 CONTINUE
  265 A(J)=XRTC(I)
      GO TO 5
  270 DO 275 I=1,NR
  275 A(I)=0.
      GO TO 5
C
C  READ DESIRED SIMULATION TIME
C
  280 IF (IOPT.NE.ITIM) GO TO 281
      START=0.
      STOPP=600.
      JSTRT=800
      JSTOP=1900
      IF (ABS(X(2)).EQ.0.) GO TO 5
      JSTRT=IFIX(X(1)+0.1)
      JSTOP=IFIX(X(2)+0.1)+100
      JMIN=JSTRT-((JSTRT/100)*100)
      TMIN1=FLOAT((JSTRT/100)*60+JMIN)
      JMIN=JSTOP-((JSTOP/100)*100)
      TMIN2=FLOAT((JSTOP/100)*60+JMIN)
      STOPP=TMIN2-TMIN1
      STOPP=STOPP-60.
C
C ******* UPDATED 11/81 FOR 24 HR TIME
C
      IF (STOPP.LE.0.) STOPP=1440.+STOPP
      CALL PHOT (IPLACE)
      CALL MIXST
      CALL SUNTIM
      GO TO 5
C
C  ZENITH ANGLE OPTION
C
  281 IF (IOPT.NE.IZNI) GO TO 285
      IPZ=IFIX(X(1)+0.1)
      DO 286 K=1,IPZ
      READ (IN,300) (XRTC(I),I=1,11)
      IPNW=IFIX(XRTC(1)+0.01)
      DO 282 J=1,IP
      IF (IPNW.EQ.IPH(J)) GO TO 283
  282 CONTINUE
      WRITE (IOUT,414) IPNW
      STOP
  283 DO 284 I=1,10
      PP(I,J)=XRTC(I+1)
      IF (J.EQ.1) RTCON(I)=RTCON(I)*XRTC(I+1)
      IF (J.EQ.1) PP(I,J)=1.
  284 CONTINUE
  286 CONTINUE
      GO TO 5
  285 IF (IOPT.NE.IBLK) WRITE (IOUT,305) IOPT
      IF (IOPT.EQ.IBLK) STOP
      GO TO 5
C
C
C
  289 FORMAT (1H1 ///////////////////
     149X,39H*************************************** /
     149X,39H*                                     * /
     149X,39H*   OZONE ISOPLETH PLOTTING PACKAGE   * /
     149X,39H*      WITH OPTIONAL MECHANISMS       * /
     149X,39H*                                     * /
     149X,39H*              O Z I P M              * /
     149X,39H*             VERSION 3.1             * /
     149X,39H*                                     * /
     149X,39H*           SEPTEMBER, 1985           * /
     149X,39H*                                     * /
     149X,39H***************************************)
  290 FORMAT (A4,6X,6F10.2)
  295 FORMAT (36A2)
  296 FORMAT (10X,36A2)
  297 FORMAT (1H1//)
  300 FORMAT (7F10.5)
  305 FORMAT (1H1,24HTHE OPTIONS INSTRUCTION ,A4,21H CANNOT BE PROCESSED
     1.)
  310 FORMAT (1H0,30X,21HMAXIMUM ONE HOUR AVE ,A4,1X,3H = ,F7.5,12H CENT
     1ERED AT,F6.0,9H LDT     )
  320 FORMAT (1H1 // 14X,36HTHE FOLLOWING RESULTS WERE READ IN. ////1H ,
     116X,2HHC,18X,3HNOX,15X,5HRATIO,17X,A4)
  325 FORMAT (1H0,4F20.5)
  330 FORMAT (6A4)
  335 FORMAT (1H0,30X,8HMAXIMUM ,A4,1X,44H NOT REACHED, THE LAST ONE HOU
     1R AVERAGE WAS ,F7.5,5H PPM.)
  385 FORMAT (7(A4,6X))
  414 FORMAT (1H0, 9HREACTION ,I10,10H NOT FOUND)
  440 FORMAT (1H1,39X,8HSPECIES ,A4,38H IS NOT FOUND IN THE KINETIC MECH
     1ANISM)
  490 FORMAT (1H1//////1H0,28HTHE INPUTS FOR THIS RUN ARE  //)
 1000 FORMAT (1X,7E13.4)
      END
      BLOCK DATA
      COMMON /CALC/ NR,KR(200,12),A(200),S(200),R(200),ITYPE(200),IA(90)
     1,JA(1500),DILUT,TEMP,ERR,START,STOPP,SPECIS(91),TPRNT,TSTEP,ZENI
      COMMON /CNTRL/ SIG,SIGMA,INFO,NPTO,TSRT,DTIM,Z1,Z2,DCON,EHC,EXN,FL
     1ST,TLST
      COMMON /HEAT/ SC(200,12),ISC(200,3)
      COMMON /SPEC/ NS,HCSPEC(15),CARB(15),RCTY(15),XNF(2),IH(15),
     1INOX(2),FINHC(15),FALHC(15),NHC,OZIN,OZAL,HCIN,HCAL,XNIN,XNAL,
     2NOZ,FENX(2),C(91),REACT(91),NI,PLSP(5),KOZ(5)
      COMMON/OPTS/ ISPD,ICAL,IACR,IDIL,IPLC,IEMS,IRDY,IBLK,IBCK,
     1IPLT,ITRN,ITIT,IRCT,IRAT,ITIM,IMCH,INIT,ISTR,IMIX,ISPC,ITMP
     2,IALF,IDEP,IZNI,IMAS,IMOL
      COMMON /EMIS/ NEM,ISP,ESTRT(5),ESTOP,ESLP,EMSP(5),IEMLS(5),EOSLP(5
     1),EMO(26,5),ECI(5),EM(26),EC(125),ECO(125,5)
      COMMON /MIX/ NMIX,AMIX(26),STRM,STOPM,DC(104)
      COMMON /MIXING/ DSTRT,DEND,AMC(5),BMC(5),CMC(5),FD(6),FG(6),
     1 AMXX(26),DL,TTMAX,SRISE,SRMIN,DELH,TDIL,NMXX,HEIGHT,SSET,SSRISE
      COMMON /TEMPER/ TEMEND,NTEMP,QM(30)
      COMMON /INOUT/ IN,IOUT,ITAPE,IALN,IALL,INHH
      COMMON /TITL/ ITTL(36)
      COMMON /NEED/ HC,XN,NL,NRTO,RTO(20),OZP(20),OZN(8,20),RHO(8,20),MR
     1,OC(4),OS(2),HCS,XNS,LS,HCLL(8),XNLL(8)
      COMMON /NEED1/ IBLANK,MBLANK,IIHC,IINX,IICO,IINO2,IINO,II03,
     1IIH2O,IBZA,JPLUS
      COMMON /HOUR/ OZM(5),NGO,TTM,TM(5)
      COMMON /PLTVEC/ HCT(20),OT(20),NT,OHC,HCG,PLTGRD,OXN,XNG,HC1,XN1,T
     1ICZ,DIGZ,CHRZ
      COMMON /VVLB1/ FCTR,DIST,CHRSIZ,NNCHR,OZBL
      COMMON /BK1/ FBK(10),FBKAL(5),HCBK,XNBK,OZBK
      COMMON /SUNLIT/ Z(10),RTCON(10),
     1LAM1,INC,SLA,SLO,TZ,IY,IM,ID,ISTRT,ISTOP,IINC,IEND,SPECIE,MAXZ,ITI
     2ME(24),XZ(24),K(24),JSTRT,JSTOP,PSPEC,MNLM,MXLM,MAXL,MAXJ
      COMMON /ZENITH/ IPZ,ZDEF(10,20),IPHZ(20),IZENP
      COMMON /PHOTON/ CF(72,20),P(24,20),IPH(20),IP,RFCT(20),PP(10,20)
      COMMON /ALOFT/ IALFT,CALFT(10),LOCALF(10),ISPAL(10)
      COMMON /DEPOS/ IDEPO,RDEPO(26,10),LOCDEP(10),ISPDP(10),RDCOEF(125,
     110),IDPTIM,DPEND,RDEP1(26,10),DNOWS
      COMMON /MCH1/ IRS(200,12)
      COMMON /GEAR1/ TTDUM(5),UROUND,NNDUM(4)
      COMMON /PLTND/ JBAR,JSYMB,CVERT(9),TVERT(52,2)
      INTEGER SPECIS,HCSPEC,PLSP,PSPEC,EMSP
C
C     PLOTTING DATA
C
      DATA JBAR/1HI/,JSYMB/1HO/
      DATA TVERT/17*4H    ,4H C  ,4H O  ,4H N  ,4H C  ,4H E  ,4H N  ,4H
     1 T  ,4H R  ,4H A  ,4H T  ,4H I  ,4H O  ,4H N  ,4H    ,4H P  ,4H P 
     2 ,4H M  ,70*4H    /
C
C  UROUND (ROUND-OFF ERROR)
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```
C
      DATA UROUND/1.25E-7/
      DATA TEMEND/0./
      DATA ISPD/4HISOP/,ICAL/4HCALC/,IACR/4HACCU/,IDIL/4HDILU/,IPLC/4HPL
     1AC/,IEMS/4HEMIS/,IRDY/4HALRE/,IBLK/4H    /,IPLT/4HPLOT/,ITRN/4HTRA
     2N /,ITIT/4HTITL/,IRCT/4HREAC/,IRAT/4HRATE/,ITIM/4HTIME/,IMCH/4HMEC
     3H/,INIT/4HINIT/,IMIX/4HMIXI/,ISPC/4HSPEC/,ISTR/4HEKMA/,IMOL/4HMOLE
     4/,I103/4HO3  /,IIHC/4HVOC /,IINX/4HNOX /,IBCK/4HBACK/,ITMP/4HTEMP/
     5,IINO2 /4HNO2 /,IINO/4HNO  /,IALF/4HALOF/,IDEP/4HDEPO/,IZNI/4HZENI
     6/,IMAS/4HMASS/
     7,IIH2O/4HH2O /,MBLANK/4HM    /,IBLANK/4H     /,JPLUS/4H+    /
C  SET DEFAULTS
      DATA HC/2.0/,XN/0.28/,NL/11/,MR/5/
      DATA ITTL/2HST,2HAN,2HDA,2HRD,2H O,2HZO,2HNE,2H I,2HSO,2HPL,2HET,
     1          2HH ,2HCO,2HND,2HIT,2HIO,2HNS,19*2H    /
C
C  FILE I/O UNITS
C
      DATA IN/5/,IOUT/6/,IALN/9/,IALL/8/
      DATA INFO/0/,NPTO/0/,NGO/1/
      DATA OZP/.08,.12,.16,.20,.24,.28,.30,.32,.34,.36,.40,9*0./
      DATA TSRT/0.0/,DTIM/420./,Z1/510./,Z2/630./,DCON/0.0/
      DATA SIG/2./,SIGMA/2./
      DATA NMIX/0/,AMIX(1)/-3./,NEM/0/
      DATA DSTRT/800./,DEND/1500./,PLTGRD/0./,OHC/0./,FCTR/0.6/
      DATA TICZ/0.07/,DIGZ/0.10/,CHRZ/0.10/,HC1/8.5/,XN1/5.95/
      DATA CHRSIZ/0.07/,QM(1)/-3./
      DATA NOZ/1/,PLSP/4HO3  ,4*4H    /,
     1KOZ/4,4*0/
C
C  DEFAULT REACTIVITIES
C
      DATA RCTY/.04,.03,.03,.02,.12,.10,.51,.15,7*0./,
     1    FINHC/.05,.03,.16,.10,.07,.06,.53,8*0./,
     2    FALHC/.06,.03,.09,.06,.08,.07,.61,8*0./,
     1XNF/.25,.75/,
     2FENX/.05,.95/,NI/0/,CARB/2.,2.,2.,1.,7.,8.,1.,1.,7*0./
      DATA HCSPEC/4HETH ,4HOLE ,4HALD2,4HFORM,4HTOL ,4HXYL ,4HPAR ,
     14HNR  ,7*4H    /
      DATA IH/48,42,18,15,52,63,33,67,7*0/,INOX/1,2/,NHC/8/
      DATA OZIN/0./,OZAL/0./,HCIN/0./,HCAL/0./,XNIN/0./,XNAL/0./
      DATA HCBK/0./,XNBK/0./,OZBK/0./,FBK/10*-3./,FBKAL/5*-3./
      DATA ERR/0.003/,TEMP/303.0/
      DATA ESTOP/0.0/,STOPP/600./,TPRNT/60./,TSTEP/60./
      DATA SLA/34.058/,SLO/118.250/,TZ/8.0/,IY/1975/,IM/6/,ID/21/
      DATA JSTRT/0800/,JSTOP/1900/,IINC/60/
C
C
C  MIXING HEIGHT DATA
C
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      DATA FD/0.,.07,.14,.33,.50,.70/
      DATA AMC/32.7892,10.9811,-26.3876,7.4405,3.4242/
      DATA BMC/0.0,6.8857,9.1918,-5.8492,-2.0545/
      DATA CMC/.1251,.6071,1.7325,2.3676,1.0239/
      DATA FG/0.,.02,.10,.58,.85,1.0/
C
C
C  DATA FOR GEAR
C
      DATA NR/148/,KR/148*100,2252*0/,NS/68/
      DATA R/200*0./,INHH/1/
      DATA SC/2400*1./,ISC/600*1/
      DATA IP/18/,RFCT/1.,1.16,.042,.18,.0014,26.,4.6,1.1,1.06,1.11,.3,
     1.00004,.0052,.0016,.0007,.02,.0003,.004,2*1./
C
C  DATA FOR SUN
C
      DATA IPHZ/1,8,39,40,48,9,21,26,30,31,62,69,72,73,74,76,94,138,
     12*0/,IPZ/18/,IZENP/-1/
      DATA RTCON/0.60009,0.59517,0.58559,0.56417,0.53177,0.48506,
     10.40872,0.28818,0.15519,0.034896/
      DATA ZDEF/10*1.
     1,0.00466,0.00455,0.00416,0.00353,0.00277,0.00192
     1,0.00111,0.000476,0.000210,0.000112
     1,0.00271,0.00270,0.00261,0.00248,0.00228,0.00201
     1,0.00164,0.00125,0.000915,0.000690
     1,0.00376,0.00375,0.00370,0.00360,0.00346,0.00326
     1,0.00299,0.00259,0.00229,0.00218
     1,0.000644,0.000624,0.000605,0.000540,0.000473,0.000374
     1,0.000274,0.000191,0.000108,0.000054,130*1.,20*0./
      DATA IPH/1,8,9,21,26,30,31,39,40,48,62,69,72,73,74,76,94,138,
     12*0/
      DATA MAXL,MAXZ,MAXJ,LAM1,INC/09,10,47,2900,100/
      DATA  Z           /0.,10.,20.,30.,40.,50.,60.,70.,78.,86./
      DATA MNLM,MXLM/2900,4500/
C
C  DATA FOR ALOFT AND DEPOSITION
C
      DATA IALFT/0/,IDEPO/0/,DPEND/0./,IDPTIM/0/,DNOWS/0./
C
C
C     DATA FOR CBMX MECHANISM
C
      DATA SPECIS/4HNO2 ,4HNO  ,4HO   ,4HO3  ,4HNO3 ,4HO1D ,4HOH  ,4HHO2
     1 ,4HN2O5,4HHNO3,4HHNO2,4HH2O2,4HPNA ,4HCO  ,4HFORM,4HFROX,4HFACD,4
     2HALD2,4HC2O3,4HMEO2,4HPAN ,4HMPNA,4HMEO ,4HMNIT,4HMEN3,4HMEOH,4HPR
     3OX,4HAONE,4HANO2,4HGLY ,4HMGLY,4HMGPX,4HPAR ,4HRO2 ,4HRO2R,4HX   ,
     44HROR ,4HNTR ,4HKET ,4HD   ,4HAO2 ,4HOLE ,4HCRIG,4HMCRG,4HHOTA,
     54HHTMA,4HPNO2,4HETH ,4HOZD ,4HACAC,4HDNIT,4HTOL ,4HOPEN,4HPHEN,
     64HBO2 ,4HPHO ,4HBZA ,4HBZO2,4HPBZN,4HPHO2,4HPROD,4HNPHN,
     74HXYL ,4HXYLO,4HTLA ,4HTLO2,4HNR  ,4HM   ,23*4H    /              B
      DATA A/1.00,4.440E+06,26.6,13800.,2320.,3120.,.0474,1.16,.042,4.29B
     10E+10,6.520E+09,100.,3.00,28100.,.59,1780.,.038,3.12,3.200E-07,1.5B
     200E-05,.18,16300.,9770.,12300.,1.456E-04,                         B
     3.0014,2520.,9770.,192.,26.,4.60,4144.,4360.,1630.,5.12,400.,      B
     414.8,15000.,1.10,1.06,237.,.93,10400.,90.,636.,24000.,3.70,1.11,  B
     55.00,16500.,9000.,.0222,6000.,92.,11000.,44400.,1920.,22200.,     B
     6376000.,2220.,2370.,.3,175.,328.,4400.,3700.,8900.,9600.,4.000E-05B
     7,580.,12000.,.0052,.0016,.0007,15000.,.02,26000.,12000.,21.,150., B
     81000.,12000.,12000.,1000.,22000.,150000.,90000.,240000.,10000.,   B
     93000.,7000.,10000.,12000.,.0003,300.,880.,                        B
     14740.,42000.,.0054,.0054,.0036,.0036,11.4,1080.,12000.,.001,.0017,B
     225.,58.,10.,7.00,200.,400.,320.,80.,10000.,1000.,120.,30.,30.,    B
     310000.,1000.,120.,30.,30.,1000.,10000.,5500.,3500.,750.,10000.,   B
     414000.,20000.,2500.,3700.,12000.,.022,.004,20000.,12000.,2000.,   B
     512000.,20000.,4000.,10000.,24000.,88.,1.00,52*0./                 B
      DATA S/0.,-6.900E+02,1.430E+03,0.,-6.000E+02,-4.110E+02,          B
     12.450E+03,0.,0.,-1.000E+02,0.,9.400E+02,5.800E+02,-2.500E+02,     B
     21.230E+03,6.000E+01,0.,1.084E+04,3*0.,-5.600E+02,-4.270E+02,      B
     3-2.400E+02,-5.300E+02,0.,1.870E+02,0.,-7.780E+02,0.,              B
     40.,-1.150E+03,-5.800E+03,-6.170E+02,1.042E+04,5*0.,1.550E+03,     B
     53*0.,9.860E+02,-2.500E+02,3*0.,-2.500E+02,-2.500E+02,1.400E+04,   B
     6-7.350E+02,1.040E+04,-1.800E+02,-2.000E+02,0.,0.,1.313E+03,       B
     73.600E+02,3.400E+02,0.,-2.200E+02,-2.200E+02,2*0.,-1.300E+03,     B
     819*0.,7.000E+03,7*0.,3.240E+02,3.240E+02,3.240E+02,-5.370E+02,    B
     90.,1.897E+03,1.897E+03,1.897E+03,0.,8.000E+02,-3.820E+02,         B
     12.840E+03,2.840E+03,29*0.,1.400E+04,63*0./                        B
C                                                                       B
      END                                                               B
      SUBROUTINE HDWRIT(IPLACE,IEM)
C
C  THIS SUBROUTINE WRITES THE HEADER PAGE FOR THE CURRENT CALCULATIONS
C
C
      COMMON /CALC/ NR,KR(200,12),A(200),S(200),R(200),ITYPE(200),IA(90)
     1,JA(1500),DILUT,TEMP,ERR,START,STOPP,SPECIS(91),TPRNT,TSTEP,ZENI
      COMMON /CNTRL/ SIG,SIGMA,INFO,NPTO,TSRT,DTIM,Z1,Z2,DCON,EHC,EXN,FL
     1ST,TLST
      COMMON /SPEC/ NS,HCSPEC(15),CARB(15),RCTY(15),XNF(2),IH(15),
     1INOX(2),FINHC(15),FALHC(15),NHC,OZIN,OZAL,HCIN,HCAL,XNIN,XNAL,
     2NOZ,FENX(2),C(91),REACT(91),NI,PLSP(5),KOZ(5)
      COMMON /SUNLIT/ Z(10),RTCON(10),
     1LAM1,INC,SLA,SLO,TZ,IY,IM,ID,ISTRT,ISTOP,IINC,IEND,SPECIE,MAXZ,ITI
     2ME(24),XZ(24),KKK(24),JSTRT,JSTOP,PSPEC,MNLM,MXLM,MAXL,MAXJ
      COMMON /PHOTON/ CF(72,20),P(24,20),IPH(20),IP,RFCT(20),PP(10,20)
      COMMON /ZENITH/ IPZ,ZDEF(10,20),IPHZ(20),IZENP
      COMMON /EMIS/ NEM,ISP,ESTRT(5),ESTOP,ESLP,EMSP(5),IEMLS(5),EOSLP(5
     1),EMO(26,5),ECI(5),EM(26),EC(125),ECO(125,5)
      COMMON /MIX/ NMIX,AMIX(26),STRM,STOPM,DC(104)
      COMMON /MIXING/ DSTRT,DEND,AMC(5),BMC(5),CMC(5),FD(6),FG(6),
     1 AMXX(26),DL,TTMAX,SSRISE,SRMIN,DELH,TDIL,NMXX,HEIGHT,SSET,SRISE
      COMMON /TEMPER/ TEMEND,NTEMP,QM(30)
      COMMON /FRPLOT/ SAVCON(80,5),SAVTIM(80),NTSV,INOW
      COMMON /INOUT/ IN,IOUT,ITAPE,IALN,IALL,INHH
      COMMON /TITL/ ITTL(36)
      COMMON /NEED/ HC,XN,NL,NRTO,RTO(20),OZP(20),OZN(8,20),RHO(8,20),MR
     1,OC(4),OS(2),HCS,XNS,LS,HCLL(8),XNLL(8)
      COMMON /HEAT/ SC(200,12),ISC(200,3)
      COMMON /NEED1/ IBLANK,MBLANK,IIHC,IINX,IICO,IINO2,IINO,II03,
     1IIH2O,IBZA,JPLUS
      COMMON /STORE/ AST(60)
      COMMON /HOUR/ OZM(5),NGO,TTM,TM(5)
      COMMON /PLTVEC/ HCT(20),OT(20),NT,OHC,HCG,PLTGRD,OXN,XNG,HC1,XN1,T
     1ICZ,DIGZ,CHRZ
      COMMON /ALOFT/ IALFT,CALFT(10),LOCALF(10),ISPAL(10)
      COMMON /DEPOS/ IDEPO,RDEPO(26,10),LOCDEP(10),ISPDP(10),RDCOEF(125,
     110),IDPTIM,DPEND,RDEP1(26,10),DNOWS
      COMMON /VVLB1/ FCTR,DIST,CHRSIZ,NNCHR,OZBL
      COMMON /BK1/ FBK(10),FBKAL(5),HCBK,XNBK,OZBK
      DIMENSION  ITMIX(26), IZC(10),XRTC(100),IPLACE(6)
      INTEGER SPECIS,HCSPEC,PLSP,PSPEC,EMSP
C
      DATA IZC/0,10,20,30,40,50,60,70,78,86/
C
      IF (IZENP.LE.0) GO TO 5
      WRITE (IOUT,311) IZC
      DO 4 K=1,IP
      J=IPH(K)
      I=KR(J,1)
      DO 3 LL=1,10
      IF (K.EQ.1) XRTC(LL)=RTCON(LL)*RFCT(K)*PP(LL,K)
      IF (K.NE.1) XRTC(LL)=PP(LL,K)*RFCT(K)*RTCON(LL)*RFCT(1)
    3 CONTINUE
      WRITE (IOUT,312) J,SPECIS(I),(XRTC(LL),LL=1,10)
    4 CONTINUE
    5 CONTINUE
      WRITE (IOUT,315) (ITTL(I),I=1,36)
      KSTOP=JSTOP-100
      WRITE (IOUT,340) IPLACE,SLA,SLO,TZ,IM,ID,IY,JSTRT,KSTOP
      NOON=SPECIE
      IRISE=SRISE
      ISET=SSET
      IF (INFO.EQ.(-1)) WRITE (IOUT,345) NOON,IRISE,ISET
      IF (NMIX.GT.0) GO TO 10
      DDTRT=FLOAT(JSTRT)+(TSRT/60.)*100.
      DDEND=DDTRT+(DTIM/60.)*100.
      WRITE (IOUT,350) Z1,Z2,DDTRT,DDEND
      ITMIX(1)=DDTRT
      NMX=INT(DTIM/60.+0.5)+1
      DO 6 J=2,NMX
    6 ITMIX(J)=ITMIX(J-1)+100
      WRITE (IOUT,460) (ITMIX(J),J=1,NMX)
      WRITE (IOUT,465) (AMXX(J),J=1,NMX)
      IF (DCON.GT.0.) WRITE (IOUT,355) DCON
      GO TO 18
   10 NMIX1=NMIX-1
      WRITE (IOUT,430) (I,I=1,NMIX1)
      WRITE (IOUT,435) (AMIX(I),I=1,NMIX)
   18 IF (QM(1).LT.0.) GO TO 15
      NTEMP1=NTEMP-1
      WRITE (IOUT,480) (I,I=1,NTEMP1)
      WRITE (IOUT,485) (QM(I),I=1,NTEMP)
   15 WRITE (IOUT,400)
      IF (NHC.NE.0) WRITE (IOUT,360) (HCSPEC(I),RCTY(I),I=1,NHC)
      IF (HCIN.GT.0.) WRITE (IOUT,450) (HCSPEC(I),FINHC(I),I=1,NHC)
      IF (HCAL.GT.0.) WRITE (IOUT,455) (HCSPEC(I),FALHC(I),I=1,NHC)
      IF (HCBK.GT.0.) WRITE (IOUT,470) (HCSPEC(I),FBK(I),I=1,NHC)
      WRITE (IOUT,405) XNF(1)
      IF (NHC.EQ.0) WRITE (IOUT,390)
      IF((OZIN+HCIN+XNIN) .GT. 0.0 .OR. (OZAL+HCAL+XNAL) .GT. 0.0)
     1 WRITE (IOUT,445)
      IF (OZIN+HCIN+XNIN.GT.0.) WRITE (IOUT,365) OZIN,HCIN,XNIN
      IF (NI.NE.0.AND.(OZIN+HCIN+XNIN.LE.0..OR.OZAL+HCAL+XNAL.LE.0.))
     1WRITE (IOUT,445)
      IF (NI.NE.0) WRITE (IOUT,410) (REACT(I),C(I),I=1,NI)
      IF (IALFT.GT.0) WRITE (IOUT,411) (ISPAL(I),CALFT(I),I=1,IALFT)
      IF (OZAL+HCAL+XNAL.GT.0.) WRITE (IOUT,370) OZAL,HCAL,XNAL
      IF (OZBK+HCBK+XNBK.GT.0.) WRITE (IOUT,475) OZBK,HCBK,XNBK
      IF (NEM.GT.0) WRITE (IOUT,375) (I,I=1,NEM)
      IF (NEM.GT.0) WRITE (IOUT,380) (EM(I),I=1,NEM)
      IF (NEM.GT.(-1)) GO TO 17
      DO 13 J=1,NS
      DO 14 I=1,ISP
      IF (EMSP(I).EQ.IIHC  .OR.EMSP(I).EQ.IINX  ) GO TO 14
      IF (SPECIS(J).NE.EMSP(I)) GO TO 14
      IEMLS(I)=J
      GO TO 13
   14 CONTINUE
   13 CONTINUE
      WRITE (IOUT,415) (J,J=1,IEM)
      DO 16 I=1,ISP
   16 WRITE (IOUT,420) EMSP(I),(EMO(J,I),J=1,IEM)
   17 CONTINUE
      IF (IDPTIM.LE.0) GO TO 19
      WRITE (IOUT,416) (J,J=1,IDPTIM)
      DO 21 I=1,IDEPO
   21 WRITE (IOUT,421) ISPDP(I),(RDEP1(J,I),J=1,IDPTIM)
   19 CONTINUE
C
      RETURN
C
C  FORMAT STATEMENTS
C
  311 FORMAT (1H1 /// 42X,48HTHE FOLLOWING PHOTOLYSIS RATE CONSTANTS ARE
     1 USED // 10X,8HREACTION,3X,7HSPECIES,43X,18HZENITH ANGLE (DEG) /
     2 12X,3HNO.,18X,I2,9I10 //)
  312 FORMAT (1H0,11X,I3,8X,A4,1X,1P10E10.2)
  315 FORMAT (1H1 // 40X,36A2)
  340 FORMAT (1H0 // 40X,40HPHOTOLYTIC RATE CONSTANTS CALCULATED FOR ///
     1,49X,6A4 /// 40X,9HLATITUDE ,F10.3 // 40X, 9HLONGITUDE ,F10.3 // 4
     20X,9HTIME ZONE,F7.1 // 40X,5HDATE ,5X,3(I4,3X) // 40X,5HTIME ,7X,I
     34,3X,2HTO,3X,I4,5X,19HLOCAL DAYLIGHT TIME)
  345 FORMAT (1H0,39X,10HSOLAR NOON,I7 / 1H0,39X,10HSUNRISE   ,I7,
     17X,10HSUNSET    ,I7)
  350 FORMAT (1H0 // 40X,39HDILUTION DETERMINED FROM THE FOLLOWING  // 4
     10X,17HINVERSION HEIGHTS,5X,7HINITIAL,F7.0,5X,5HFINAL,4X,F7.0 // 40
     2X,7HTIMING ,15X,5HSTART,F9.0,5X,4HSTOP,4X,F8.0)
  355 FORMAT (1H0,39X,55HDILUTION RATE BEFORE AND AFTER THE INVERSION CH
     1ANGE WAS // 37X,1PE12.3,9H PER MIN.)
  360 FORMAT ((1H0,39X,10HEMISSIONS ,6X,3(A4,9H FRACTION,F6.3,3X)))
  365 FORMAT (/ 40X,13HSURFACE LAYER,9X,5HOZONE,F8.3,6X,11HHYDROCARBON,F
     17.3,4X,3HNOX,F10.3,4H PPM)
  370 FORMAT (/ 40X,5HALOFT,17X,5HOZONE,F8.3,6X,11HHYDROCARBON,F7.3,4X,3
     1HNOX,F10.3,4H PPM)
  375 FORMAT (1H0 // 40X,50HCONTINUOUS EMISSIONS (EXPRESSED AS THE FRACT
     1ION OF // 40X,54HINITIAL NON-BACKGROUND CONCENTRATION EMITTED PER
     2HOUR) // 40X,4HHOUR,3X,10I6 / 47X,7I6)
  380 FORMAT (1H0,39X,8HFRACTION,10F6.3 / 48X,7F6.3)
  390 FORMAT (1H0,39X,42HTHERE ARE NO HYDROCARBONS IN THE MECHANISM)
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400 FORMAT (// 40X,10HREACTIVITY)                                       C   151
405 FORMAT (1H0,39X,7HNO2/NOX,6X,F6.3)                                  C   152
410 FORMAT ((1H0,39X,13HSURFACE LAYER,9X,A4,1X,F8.3,6X,A4,5X,F9.3       C   153
   1,4X,A4,F9.3,4H PPM))                                                C   154
411 FORMAT ((1H0,39X,13HALOFT        ,9X,A4,1X,F8.3,6X,A4,5X,F9.3       C   155
   1,4X,A4,F9.3,4H PPM))                                                C   156
415 FORMAT (1H0 // 40X,70HCONTINUOUS EMISSIONS (EXPRESSED AS FRACTION C   157
   1OF THE INITIAL PRECURSORS)                                          C   158
   2     // 40X,7HSPECIES,5X,4HHOUR,5X,10I6 / 61X,10I6 / 61X,10I6)      C   159
416 FORMAT (1H0 // 40X,58HSURFACE DEPOSITION RATES (CM/SEC)             C   160
   1                     // 40X,14H                                     C   161
   2     // 40X,7HSPECIES,5X,4HHOUR,5X,10I6 / 61X,10I6 / 61X,10I6)      C   162
420 FORMAT (1H0,41X,A4,4X,8HFRACTION,4X,10F6.3 / 62X,10F6.3 /           C   163
   1     62X,10F6.3)                                                    C   164
421 FORMAT (1H0,41X,A4,4X,8HRATE    ,4X,10F6.3 / 62X,10F6.3 /           C   165
   1     62X,10F6.3)                                                    C   166
425 FORMAT (1H0 // 40X,58HCONTINUOUS EMISSIONS (EXPRESSED AS THE FRACTC   167
   1ION OF INITIAL // 40X,50HNON-BACKGROUND NOX CONCENTRATION EMITTED C   168
   2PER HOUR) // 45X,4HHOUR,3X,11I6 / 52X,4I6)                          C   169
430 FORMAT (1H0 // 40X,39HDILUTION DETERMINED FROM THE FOLLOWING  // 4C   170
   10X,49HINVERSION HEIGHTS (AT THE BEGINNING OF EACH HOUR) // 40X,4HHC   171
   2OUR,9X,1H0,9I8 / 46X,10I8 / 46X,10I8)                               C   172
435 FORMAT (1H0,39X,7HHEIGHT   ,10F8.1 / 47X,10F8.1 / 47X,10F8.1)       C   173
445 FORMAT (1H1 // 40X,26HTRANSPORTED CONCENTRATIONS )                  C   174
450 FORMAT ((1H0,39X,13HSURFACE LAYER,3X,3(A4,9H FRACTION,F6.3,3X)))  C   175
455 FORMAT ((1H0,39X,6HALOFT ,10X,3(A4,9H FRACTION,F6.3,3X)))           C   176
460 FORMAT (1H0 //40X,46HMIXING HEIGHTS (AT THE BEGINNING OF EACH HOURC   177
   1) // 40X,4HTIME,2X,10I8/46X,10I8/46X,10I8)                          C   178
465 FORMAT (1H0,39X,6HHEIGHT,2X,10F8.1/48X,10F8.1/48X,10F8.1)           C   179
470 FORMAT ((1H0,39X,13HBACKGROUND   ,3X,3(A4,9H FRACTION,F6.3,3X)))  C   180
475 FORMAT (/ 40X,13HBACKGROUND   ,9X,5HOZONE,F8.3,6X,11HHYDROCARBON,FC   181
   17.3,4X,3HNOX,F10.3,4H PPM)                                          C   182
480 FORMAT (1H0 // 40X,43HTEMPERATURE (AT THE BEGINNING OF EACH HOUR) C   183
   1   // 40X,4HHOUR,9X,1H0,9I8 / 46X,10I8 / 46X,10I8)                  C   184
485 FORMAT (1H0,39X,7HTEMP       ,10F8.1 / 48X,10F8.1 / 48X,10F8.1)     C   185
    END                                                                 C   186-
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      SUBROUTINE MECH                                                   D
      COMMON /CALC/ NR,KR(200,12),A(200),S(200),R(200),ITYPE(200),IA(90)D
     1,JA(1500),DILUT,TEMP,ERR,START,STOPP,SPECIS(91),TPRNT,TSTEP,ZENI  D
      COMMON /PHOTON/ CF(72,20),P(24,20),IPH(20),IP,RFCT(20),PP(10,20)  D
      COMMON /ZENITH/ IPZ,ZDEF(10,20),IPHZ(20),IZENP                    D
      DIMENSION K1(400),K2(400),K3(1600)                                D
C                                                                       D
      DATA K1/1,3,4,3*3,1,4,4,6,6,4,4,3*5,9,9,2,2*11,1,2,8,2,12,3*7,2*5,D
     18,8,8,13,7,6*15,2*16,5*18,2*19,21,20,22,20,4*23,25,2*24,3*20,19,20D
     2,19,2*28,29,4*30,2*31,32,7,2*33,34,2*35,4*37,36,3*40,41,39,3*3,   D
     37,4*4,5,3,7,4,4,4*45,4*46,5*43,5*44,2*47,3*52,53,54,57,58,58,55   D
     4,59,57,56,60,63,64,65,66,2*63,7,67,54*0,2,1,1,2,4,4*0,7,8,2,1,1,0,D
     50,1,11,0,7,7,2,2,0,12,11,10,0,0,8,8,1,0,14,8,7,0,0,3,5,2,0,3,7,   D
     65,0,8,2,1,0,1,0,3*2,1,0,7,7,0,2*20,2*19,2*8,0,7,2,3*0,7,0,7,2,0,  D
     77,7,3*2,1,3*0,3*33,39,2,0,9*42,4*48,8*0,2,1,0,15,18,2,1,0,15,18,2,D
     82,3*7,2,5,7,1,2,2,0,0,1,2,7,2,7,2,7,7,54*0/                       D
      DATA K2/200*0,2,4,1,2,5,1,5,6,                                    D
     13,3,7,8,7,1,2,9,10,5,11,2,2,10,11,7,1,7,8,1,5,1,2,2*12,13,2*8,16,8D
     2,8,14,7,10,17,8,3*19,3*20,21,19,22,20,23,24,15,25,3*15,2*23,15,23,D
     320,2*27,20,29,1,2*14,2*8,19,32,19,20,34,35,2*1,2*38,39,18,28,0,34,D
     441,19,1,19,20,34,18,20,18,15,18,15,47,2*20,2*15,0,14,8,17,0,2*20,8D
     5,2*15,17,2*49,2*18,50,2*49,51,38,53,54,55,1,56,58,59,2*1,58,61,62,D
     61,64,1,66,1,8,53,8,67,52*0/                                       D
      DATA K3/3,9*0,7,0,0,1,1,0,10,1,11,1,7,0,0,1,1,7                   D
     1,3*0,3,4*0,1,0,0,14,8,0,2*8,1,15,7,0,10,8,15,1,0,1,0,1,1,0,8,0,8,1D
     2,2*2,23,26,2*20,0,0,19,0,15,14,15,8,14,8,0,1,3*0,8,37,0,0,8,2*40,0D
     3,0,2*36,8,34,19,8,0,18,43,44,45,46,0,8,15,43,45,0,0,8,0,0,14,8,14 D
     4,1,5,3*0,1,5,4*0,8,30,8,0,8,10,2*0,60,57,1,2*0,56,0,8,0,56,54,31,9D
     52*0,14,0,2*14,8,4*0,14,8*0,2,13*0,19,2*0,3*14,5*0,18,4*0,2*36,2*0,D
     636,0,28,2*36,14,0,5*36,0,14,8*0,7,0,15,11*0,1,0,33,0,31,3*0,14,8,5D
     7*0,65,0,33,33,128*0,14,7*0,36,5*0,36,5*0,36,0,36,18*0,8,15*0,30,12D
     8*0,33,33,1055*0/                                                  D
C                                                                       D
C  PUT SPECIES LOCATIONS INTO KR ARRAY                                  D
C                                                                       D
      DO 2 J=1,2                                                        D
      DO 1 I=1,200                                                      D
      II=(J-1)*200+I                                                    D
      KR(I,J)=K1(II)                                                    D
      KR(I,J+2)=K2(II)                                                  D
    1 CONTINUE                                                          D
    2 CONTINUE                                                          D
      DO 4 J=5,12                                                       D
      DO 3 I=1,200                                                      D
      II=(J-5)*200+I                                                    D
      KR(I,J)=K3(II)                                                    D
    3 CONTINUE                                                          D
    4 CONTINUE                                                          D
C                                                                       D
C  PLACE ZENITH ANGLE DEPENDENCE INTO APPROPRIATE SLOT FOR EACH REACTIOND
```

```
C
      DO 9 K=1,IP
      DO 7 J=1,IPZ
      IF (IPH(K).NE.IPHZ(J)) GO TO 7
      DO 6 I=1,10
      PP(I,K)=ZDEF(I,J)
    6 CONTINUE
      GO TO 9
    7 CONTINUE
      DO 8 I=1,10
      PP(I,K)=1.0
    8 CONTINUE
    9 CONTINUE
C
      DO 20 I=1,IP
      J=IPH(I)
      RFCT(I)=A(J)
   20 CONTINUE
C
      RETURN
      END
      SUBROUTINE MCHSET (NX,NEPA)
      COMMON /CALC/ NR,KR(200,12),A(200),S(200),R(200),ITYPE(200),IA(90)
     1,JA(1500),DILUT,TEMP,ERR,START,STOPP,SPECIS(91),TPRNT,TSTEP,ZENI
      COMMON /SPEC/ NS,HCSPEC(15),CARB(15),RCTY(15),XNF(2),IH(15),
     1INOX(2),FINHC(15),FALHC(15),NHC,OZIN,OZAL,HCIN,HCAL,XNIN,XNAL,
     2NOZ,FENX(2),C(91),REACT(91),NI,PLSP(5),KOZ(5)
      COMMON /HEAT/ SC(200,12),ISC(200,3)
      COMMON /NEED1/ IBLANK,MBLANK,IIHC,IINX,IICO,IINO2,IINO,IIO3,
     1IIH2O,IBZA,JPLUS
      COMMON /STORE/ AST(60)
      COMMON /INOUT/ IN,IOUT,ITAPE,IALN,IALL,INHH
      COMMON /MCH1/ IRS(200,12)
      COMMON /PHOTON/ CF(72,20),P(24,20),IPH(20),IP,RFCT(20),PP(10,20)
      DIMENSION KRS(12),SC1(12),IPL(12)
      INTEGER SPECIS,AST
      DATA JMINUS/1H-/
      ICOUNT=0
      NR=0
      NS=1
      MORX=IBLANK
      DO 5 I=1,200
      A(I)=0.
      S(I)=0.
      R(I)=0.
      DO 5 J=1,12
      IRS(I,J)=IBLANK
      IF (I.EQ.1) KRS(J)=IBLANK
      SC(I,J)=1.
    5 KR(I,J)=0
   10 NS=NS-1
      WRITE (IOUT,40)
   15 IF (NEPA.LE.0)
     1READ (IN,30) (KRS(I),I=1,3),J,SC1(1),KRS(4),MORX,(SC1(LL-3),KRS(LL
     2),LL=5,6),RTE,ENERGY
C
C  CHECK FOR MORE PRODUCTS
C
      IF (MORX.NE.IBLANK.AND.NEPA.LE.0)
     1READ (IN,31) (SC1(II-3),KRS(II),II=7,12)
      IF (NEPA.GT.0)
     1READ (IN,32) J,(KRS(I),I=1,7),RTE,ENERGY
      IF (NEPA.GT.0) GO TO 17
      DO 16 II=7,12
      IF (MORX.NE.IBLANK.AND.NEPA.LE.0) GO TO 16
      SC1(II)=1.
      KRS(II)=IBLANK
   16 CONTINUE
   17 DO 18 II=1,12
   18 IRS(J,II)=KRS(II)
      A(J)=RTE
      S(J)=ENERGY
      DO 50 II=4,12
   50 SC(J,II)=SC1(II-3)
   55 DO 60 I=1,12
   60 IF (ABS(SC(J,I)).EQ.0.) SC(J,I)=1.
      DO 75 K=1,12
      NL=K*5
      NF=NL-4
      DO 65 LK=NF,NL
   65 AST(LK)=IBLANK
      IPL(K)=IBLANK
      IF (IRS(J,K).EQ.IBLANK) GO TO 70
      IPL(K)=JPLUS
      IF (K.EQ.1.OR.K.EQ.4) IPL(K)=IBLANK
      IF (SC(J,K).LT.0.) IPL(K)=JMINUS
   70 KK = K
      IF (IRS(J,K).NE.IBLANK) CALL VALU (SC(J,K),KK,NF,NL)
   75 CONTINUE
      ICOUNT=ICOUNT+2
      IF (IRS(J,8).NE.IBLANK) ICOUNT=ICOUNT+1
      IF (IRS(J,12).NE.IBLANK) ICOUNT=ICOUNT+1
      IF (ICOUNT.GT.50) WRITE (IOUT,40)
      IF (ICOUNT.GT.50) ICOUNT=2
      WRITE (IOUT,35)
     1           J,IPL(1),(AST(I),I=1,5),IRS(J,1),IPL(2),(AST(I),I=6,10),
     1IRS(J,2),IPL(3),(AST(I),I=11,15),IRS(J,3),IPL(4),(AST(I),I=16,20),
     2IRS(J,4),IPL(5),(AST(I),I=21,25),IRS(J,5),IPL(6),(AST(I),I=26,30),
     3IRS(J,6),IPL(7),(AST(I),I=31,35),IRS(J,7),A(J),S(J)
      IF (MORX .NE. IBLANK .AND. IRS(J,12) .EQ. IBLANK)
     1 WRITE (IOUT,36) IPL(8),(AST(I),I=36,40),
     1IRS(J,8),IPL(9),(AST(I),I=41,45),IRS(J,9),
     2IPL(10),(AST(I),I=46,50),IRS(J,10),
     3IPL(11),(AST(I),I=51,55),IRS(J,11)
      IF (MORX.NE.IBLANK.AND.IRS(J,12).NE.IBLANK)
     1WRITE (IOUT,36) IPL(12),(AST(I),I=56,60),IRS(J,12)
      KR(J,1)=100
      IF (IP.EQ.0) GO TO 25
      DO 20 I=1,IP
      IF (J.NE.IPH(I)) GO TO 20
      RFCT(I)=A(J)
      GO TO 25
   20 CONTINUE
   25 IF (J.GT.NR) NR=J
      IF (J.NE.NX) GO TO 15
      CALL MATRX
      RETURN
C
   30 FORMAT (2(A4,2X),A4,I3,F5.1,A4,A1,1X,2(F5.0,1X,A4,2X),F10.2,1X,F7.
     12)
   31 FORMAT (6(F5.0,1X,A4,2X))
```

```
32 FORMAT (I3,2X,7(A4,1X),2F10.2)
35 FORMAT (/2X,I3,1X,3(A1,5A1,1X,A4,2X),1H=,1X,3(A1,5A1,1X,A4,2X),
  1A1,5A1,1X,A4,3X,1PE11.3,2X,E13.3)
36 FORMAT (45X,2X,4(A1,5A1,1X,A4,2X))
40 FORMAT (1H1////1H0,14H THE REACTIONS,86X,13HRATE CONSTANT,2X,15HACE
  1T. ENERGY(K)  )
   END
```

```
      SUBROUTINE MATRX
      COMMON /CALC/ NR,IR(200,12),A(200),S(200),R(200),ITYPE(200),IA(90)
     1,JA(1500),DILUT,TEMP,ERR,START,STOPP,SPECIS(91),TPRNT,TSTEP,ZENI
      COMMON /SPEC/ NS,HCSPEC(15),CARB(15),RCTY(15),XNF(2),IH(15),
     1INOX(2),FINHC(15),FALHC(15),NHC,OZIN,OZAL,HCIN,HCAL,XNIN,XNAL,
     2NOZ,FENX(2),C(91),REACT(91),NI,PLSP(5),KOZ(5)
      COMMON /GEAR1/ TTDUM(5),UROUND,NNDUM(4)
      COMMON /HEAT/ SC(200,12),ISC(200,3)
      COMMON /NEED1/ IBLANK,MBLANK,IIHC,IINX,IICO,IINO2,IINO,IIO3,
     1IIH2O,IBZA,JPLUS
      COMMON /STORE/ AST(60)
      COMMON /MCH1/ KR(200,12)
      INTEGER SPECIS
      NOLD=NS+1
      DO 90 I=1,NR
C
C     SKIP REACTIONS ALREADY PROCESSED
C
      IF (IR(I,2).EQ.NOLD.OR.IR(I,3).EQ.NOLD) IR(I,3)=99
      IF (IR(I,2).EQ.NOLD) IR(I,2)=0
      IF (IR(I,1).EQ.NOLD) IR(I,1)=99
      IF (IR(I,1).EQ.NOLD) IR(I,3)=99
      IF (IABS(IR(I,1)).NE.100) GO TO 90
C
C     ZERO OUT REACTIONS
C
      DO 2 J=2,12
    2 IR(I,J) = 0
C
C     IF LESS THAN THREE REACTANTS, FILL FIRST SLOTS.
C
      IF (KR(I,1).NE.IBLANK) GO TO 5
      IF (KR(I,3).NE.IBLANK) KR(I,1)=KR(I,3)
      IF (KR(I,3).NE.IBLANK) SC(I,1)=SC(I,3)
      SC(I,3)=1.
      KR(I,3)=IBLANK
      IF (KR(I,1).NE.IBLANK) GO TO 5
      KR(I,1)=KR(I,2)
      KR(I,2)=IBLANK
      SC(I,1)=SC(I,2)
      SC(I,2)=1.
    5 IF (KR(I,2).NE.IBLANK) GO TO 10
      IF (KR(I,3).NE.IBLANK) SC(I,2)=SC(I,3)
      SC(I,3)=1.
      IF (KR(I,3).NE.IBLANK) KR(I,2)=KR(I,3)
      KR(I,3)=IBLANK
   10 DO 15 K=4,12
C
C     GET RID OF M AS A PRODUCT
C
```

```
      IF (KR(I,K).EQ.MBLANK) KR(I,K)=IBLANK
   15 CONTINUE
C
C     IF LESS THAN FOUR PRODUCTS, FILL FIRST SLOTS.
C
      DO 35 K=4,11
         IF (KR(I,K) .NE. IBLANK) GO TO 35
         DO 20 KK=K,11
            KKK = KK + 1
            SC(I,KK) = SC(I,KKK)
            KR(I,KK) = KR(I,KKK)
   20    CONTINUE
         KR(I,12) = IBLANK
         SC(I,12) = 1.0
   35 CONTINUE
C
   40 DO 85 J=1,12
      K=KR(I,J)
C
C     PROCESS REACTANTS HERE
C
      IF (J.GT.3) GO TO 65
C
C     ALL M DEPENDENT REACTIONS ARE TO HAVE A 99 IN THE THIRD SLOT
C
      IF (K.NE.MBLANK) GO TO 60
      GO TO (45,50,55),J
   45 KR(I,1)=KR(I,2)
      SC(I,1)=SC(I,2)
   50 KR(I,2)=KR(I,3)
      SC(I,2)=SC(I,3)
      SC(I,3)=1.
      KR(I,3)=MBLANK
   55 IR(I,3)=99
   60 K=KR(I,J)
C
C     ZERO ORDER REACTIONS HAVE 99 IN FIRST SLOT
C
      IF (KR(I,1).EQ.IBLANK) IR(I,1)=99
      IF (KR(I,1).EQ.IBLANK) K=99
C
C     ALL BLANKS ARE SET EQUAL TO ZERO
C
      IF (J.EQ.3.AND.K.EQ.MBLANK) K=99
   65 IF (K.EQ.MBLANK.OR.K.EQ.IBLANK) IR(I,J)=0
      IF (K.EQ.IBLANK.OR.K.EQ.99) GO TO 85
      IF (NS.NE.0) GO TO 70
      NS=1
      GO TO 80
   70 DO 75 L=1,NS
```

```
      IF (K.NE.SPECIS(L)) GO TO 75
C
C     SLOT SET TO SPECIES NUMBER
C
      IR(I,J)=L
      GO TO 85
   75 CONTINUE
C
C     IF NO SPECIES ARE FOUND, ADD ONE TO THE LIST
C
      IF (SPECIS(NS).NE.MBLANK) NS=NS+1
   80 SPECIS(NS)=K
      C(NS+1)=C(NS)
      C(NS)=0.
      IR(I,J)=NS
   85 CONTINUE
   90 CONTINUE
      IF (SPECIS(NS).NE.MBLANK) NS=NS+1
      SPECIS(NS)=MBLANK
      DO 95 IK=1,NR
      DO 95 MT=1,3
      J=IFIX(SC(IK,MT)+UROUND)
      ISC(IK,MT)=J
   95 IF (SC(IK,MT)-FLOAT(J).GT.4.*UROUND) ISC(IK,MT)=-1
      RETURN
      END
      SUBROUTINE MCHWRT
      COMMON /CALC/ NR,KR(200,12),A(200),S(200),R(200),ITYPE(200),IA(90)
     1,JA(1500),DILUT,TEMP,ERR,START,STOPP,SPECIS(91),TPRNT,TSTEP,ZENI
      COMMON /SPEC/ NS,HCSPEC(15),CARB(15),RCTY(15),XNF(2),IH(15),
     1INOX(2),FINHC(15),FALHC(15),NHC,OZIN,OZAL,HCIN,HCAL,XNIN,XNAL,
     2NOZ,FENX(2),C(91),REACT(91),NI,PLSP(5),KOZ(5)
      COMMON /HEAT/ SC(200,12),ISC(200,3)
      COMMON /NEED1/ IBLANK,MBLANK,IIHC,IINX,IICO,IINO2,IINO,II03,
     1IIH20,IBZA,JPLUS
      COMMON /STORE/ AST(60)
      COMMON /INOUT/ IN,IOUT,ITAPE,IALN,IALL,INHH
      COMMON /PHOTON/ CF(72,20),P(24,20),IPH(20),IP,RFCT(20),PP(10,20)
      DIMENSION KRS(12),SC1(12),IPL(12)
      INTEGER SPECIS,AST
      DATA JMINUS/1H-/
C
      ICOUNT=0
      WRITE (IOUT,40)
      DO 99 J=1,NR
      IR=KR(J,1)
      IF (IR.EQ.0.OR.A(J).EQ.0.) GO TO 99
      DO 1 I=1,12
      II=KR(J,I)
      IF (II.GT.0) KRS(I)=SPECIS(II)
      IF (II.LE.0) KRS(I)=IBLANK
    1 CONTINUE
C
      DO 75 K=1,12
      NL=K*5
      NF=NL-4
      DO 65 LK=NF,NL
   65 AST(LK)=IBLANK
      IPL(K)=IBLANK
      IF (KRS(K).EQ.IBLANK) GO TO 70
      IPL(K)=JPLUS
      IF (K.EQ.1.OR.K.EQ.4) IPL(K)=IBLANK
      IF (SC(J,K).LT.0.) IPL(K)=JMINUS
   70 KK = K
      IF (KRS(K).NE.IBLANK) CALL VALU (SC(J,K),KK,NF,NL)
   75 CONTINUE
      ICOUNT=ICOUNT+2
      IF (KRS(8).NE.IBLANK) ICOUNT=ICOUNT+1
      IF (KRS(12).NE.IBLANK) ICOUNT=ICOUNT+1
      IF (ICOUNT.GT.50) WRITE (IOUT,40)
      IF (ICOUNT.GT.50) ICOUNT=2
      WRITE (IOUT,35)
     1          J,IPL(1),(AST(I),I=1,5),KRS(1),IPL(2),(AST(I),I=6,10),
     1KRS(2),IPL(3),(AST(I),I=11,15),KRS(3),IPL(4),(AST(I),I=16,20),
     2KRS(4),IPL(5),(AST(I),I=21,25),KRS(5),IPL(6),(AST(I),I=26,30),
     3KRS(6),IPL(7),(AST(I),I=31,35),KRS(7),A(J),S(J)
```

```
      IF (KRS(8) .NE. IBLANK.AND.KRS(12).EQ.IBLANK)
     1 WRITE (IOUT,36) IPL(8),(AST(I),I=36,40),
     1KRS(8),IPL(9),(AST(I),I=41,45),KRS(9),
     2IPL(10),(AST(I),I=46,50),KRS(10),
     3IPL(11),(AST(I),I=51,55),KRS(11)
      IF (KRS(12).NE.IBLANK)
     1WRITE (IOUT,36) IPL(12),(AST(I),I=56,60),KRS(12)
   99 CONTINUE
      RETURN
C
   30 FORMAT (2(A4,2X),A4,I3,F5.1,A4,A1,1X,2(F5.0,1X,A4,2X),F10.2,1X,F7.
     12)
   31 FORMAT (6(F5.0,1X,A4,2X))
   32 FORMAT (I3,2X,7(A4,1X),2F10.2)
   35 FORMAT (/2X,I3,1X,3(A1,5A1,1X,A4,2X),1H=,1X,3(A1,5A1,1X,A4,2X),
     1A1,5A1,1X,A4,3X,1PE11.3,2X,E13.3)
   36 FORMAT (45X,2X,4(A1,5A1,1X,A4,2X))
   40 FORMAT (1H1////1H0,14H THE REACTIONS,86X,13HRATE CONSTANT,2X,15HAC
     1T. ENERGY(K)  )
      END
      SUBROUTINE MIXSET
      COMMON /MIX/ NMIX,AMIX(26),STRM,STOPM,DC(104)
      STRM=0.
      STOPM=FLOAT(NMIX-1)*60.
      NMX4=(NMIX-1)*3
      DO 5 I=1,NMX4
    5 DC(I)=0.
      NMIX1=NMIX-1
      DO 10 I=1,NMIX1
      K=3*I-2
      DC(K)=(AMIX(I+1)-AMIX(I))/60.
   10 CONTINUE
      RETURN
      END
      SUBROUTINE MIXST
      COMMON /SUNLIT/ Z(10),RTCON(10),
     1LAM1,INC,SLA,SLO,TZ,IY,IM,ID,ISTRT,ISTOP,IINC,IEND,SPECIE,MAXZ,ITI
     2ME(24),XZ(24),K(24),JSTRT,JSTOP,PSPEC,MNLM,MXLM,MAXL,MAXJ
      COMMON /CNTRL/ SIG,SIGMA,INFO,NPTO,TSRT,DTIM,Z1,Z2,DCON,EHC,EXN,FL
     1ST,TLST
      COMMON /MIXING/ DSTRT,DEND,A(5),B(5),C(5),FD(6),
     1Y(6),AMIX(26),DL,TTMAX,SRISE,HMIN,DELH,TDIL,NMIX,HTT,SSET,SSRISE
      INTEGER PSPEC
C
C --- DETERMINE TIME OF SUNRISE (STANDARD TIME)
C
      T=400.
   10 CALL SOLAR(SLA,SLO,TZ,IY,IM,ID,T,D,5)
      IF(D.GE.1.) GO TO 15
      T=CLOCK(T,5)
      GO TO 10
C
C --- CONVERT SUNRISE TO LOCAL DAYLIGHT TIME
C
   15 TSR=CLOCK(T,60)
      IF(TSR.LT.0600.) TSR=0600.
C
C --- DETERMINE SOLAR DECLINATION AND DAY LENGTH
C
      CALL SOLAR(SLA,SLO,TZ,IY,IM,ID,1200.,D,1)
      D=D*3.14159/180.
      ARG1=-TAN(0.67399)*TAN(D)
      DL=ACOS(ARG1)/3.14159*1440.
      IDL=DL
      TSS=CLOCK(TSR,IDL)
C
C --- COMPUTE TIME MAXIMUM HEIGHT IS REACHED
C
      TMAX=.70*DL
      ITMAX=TMAX
      TTMAX=CLOCK(TSR,ITMAX)
C
C --- CONVERT ALL 2400 HOUR TIMES TO MINUTES AFTER SUNRISE
C
      SRISE=(FLOAT(IFIX(TSR/100.))*60.)+
     1 (TSR-(FLOAT(IFIX(TSR/100.))*100.))
      DDSTRT=(FLOAT(IFIX(DSTRT/100.))*60.)+
     1 (DSTRT-(FLOAT(IFIX(DSTRT/100.))*100.))
      DDEND=(FLOAT(IFIX(DEND/100.))*60.)+
     1 (DEND-(FLOAT(IFIX(DEND/100.))*100.))
      DDSTRT=DDSTRT-SRISE
      DDEND=DDEND-SRISE
C
C --- COMPUTE HMIN AND DELTA HEIGHT
```

```
C
      FD1=DDSTRT/DL
      FD2=DDEND/DL
      DO 40 J=1,5
      IF(FD1.GE.FD(J).AND.FD1.LT.FD(J+1)) II=J
      IF(FD2.GE.FD(J).AND.FD2.LT.FD(J+1)) JJ=J
   40 CONTINUE
      IF(FD1.GE.0.0) GO TO 25
      FD1=0.0
      II=1
   25 IF(FD2.LT.0.70) GO TO 20
      FD2=.7
      JJ=6
   20 CONTINUE
      X=FD1-FD(II)
      XX=FD2-FD(JJ)
      FG1=((A(II)*X+B(II))*X+C(II))*X+Y(II)
      FG2=((A(JJ)*XX+B(JJ))*XX+C(JJ))*XX+Y(JJ)
      DELH=(Z2-Z1)/(FG2-FG1)
      HMIN=Z1-FG1*DELH
      HMAX=HMIN+DELH
C
C --- COMPUTE MIXING HEIGHTS AT HOURLY INTERVALS
C
      NMIX=0
      JJSTP=JSTOP-100
      IT=JSTRT/100
      T=IT*100
      IF (DEND.GT.TTMAX) DEND=TTMAX
      DO 70 J=1,26
      IF(T.LT.DSTRT) GO TO 55
      IF(T.GE.DEND) GO TO 60
      TT=(FLOAT(IFIX(T/100.))*60.)+(T-(FLOAT(IFIX(T/100.)))*100.)
      TT=TT-SRISE
      FDT=TT/DL
      IF(FDT.LT.0.0) FDT=0.0
      KK=0
   45 KK=KK+1
      IF(FDT.GE.FD(KK).AND.FDT.LT.FD(KK+1)) GO TO 50
      IF(KK.LT.5) GO TO 45
      IF(FDT.GE.FD(6)) GO TO 60
   50 CONTINUE
      X=FDT-FD(KK)
      FG=((A(KK)*X+B(KK))*X +C(KK))*X+Y(KK)
      AMIX(J)=HMIN+FG*DELH
      NMIX=NMIX+1
      IF (T.GE.FLOAT(JJSTP)) GO TO 80
      GO TO 65
   55 AMIX(J)=Z1
      NMIX=NMIX+1
   GO TO 65
60 AMIX(J)=Z2
   NMIX=NMIX+1
65 CONTINUE
   T=T+100.
70 CONTINUE
80 CONTINUE
   IF(DEND.GT.TTMAX) DEND=TTMAX
   RETURN
   END
```

```
      SUBROUTINE RATES (C,N)
      COMMON /CALC/ NR,KR(200,12),A(200),S(200),R(200),ITYPE(200),IA(90)
     1,JA(1500),DILUT,TEMP,ERR,START,STOPP,SPECIS(91),TPRNT,TSTEP,ZENI
      COMMON /SPEC/ NS,HCSPEC(15),CARB(15),RCTY(15),XNF(2),IH(15),
     1INOX(2),FINHC(15),FALHC(15),NHC,OZIN,OZAL,HCIN,HCAL,XNIN,XNAL,
     2NOZ,FENX(2),CR(91),REACT(91),NI,PLSP(5),KOZ(5)
      DIMENSION C(N)
      DIMENSION SIG(91)
      INTEGER SPECIS,REACT,HCSPEC
      FCT=(1./298.)-(1./TEMP)
      DO 5 I=1,91
    5 SIG(I)=0.
      IF (N.LE.0) GO TO 20
      DO 15 I=1,N
      DO 10 J=1,NS
      IF (SPECIS(J).EQ.REACT(I)) SIG(J)=C(I)
      IF (SPECIS(J).EQ.REACT(I)) GO TO 15
   10 CONTINUE
      SIG(NS+1)=SIG(NS+1)+C(I)
   15 CONTINUE
   20 N=NS
      M=N-1
      C(N)=0.
      DO 25 I=1,M
      C(N)=C(N)+SIG(I)
   25 C(I)=SIG(I)
      BK=0.
      C(N)=C(N)+SIG(NS+1)
      IF (SIG(N).NE.0.) BK=SIG(N)-C(N)
      IF (SIG(N).NE.0.) C(N)=SIG(N)
      NP=0
      DO 35 I=1,NR
      IF (KR(I,1).EQ.0) GO TO 35
      ITYPE(I)=2
      IF (KR(I,1).EQ.99.AND.KR(I,3).EQ.99) KR(I,1)=N
      IF (KR(I,1).EQ.N.AND.KR(I,3).EQ.99) KR(I,3)=0
      IF (KR(I,2).EQ.0.AND.KR(I,3).EQ.99) KR(I,2)=N
      IF (KR(I,2).EQ.N.AND.KR(I,3).EQ.99) KR(I,3)=0
      IF (KR(I,2).EQ.0) ITYPE(I)=1
      IF (KR(I,3).NE.0) ITYPE(I)=3
      IF (KR(I,3).EQ.99) KR(I,3)=N
      DO 30 J=4,12
      IF (KR(I,J).LT.0) KR(I,J)=-KR(I,J)
   30 CONTINUE
      IF (ABS(S(I)).EQ.0.) R(I)=A(I)
      IF (ABS(S(I)).NE.0.) R(I)=A(I)*EXP(S(I)*FCT)
   35 CONTINUE
      RETURN
      END
      SUBROUTINE SPARS (IA,JA,N)
      COMMON /CALC/ NR,KR(200,12),A(200),S(200),R(200),ITYPE(200),IB(90)
     1,JB(1500),DILUT,TEMP,ERR,START,STOPP,SPECIS(91),TPRNT,TSTEP,ZENI
      COMMON /SPEC/ NS,HCSPEC(15),CARB(15),RCTY(15),XNF(2),IH(15),
     1INOX(2),FINHC(15),FALHC(15),NHC,OZIN,OZAL,HCIN,HCAL,XNIN,XNAL,
     2NOZ,FENX(2),C(91),REACT(91),NI,PLSP(5),KOZ(5)
      DIMENSION IA(N), JA(N)
      DO 5 I=1,N
    5 IA(I)=1
      KT=0
      IA(N+1)=1
      JA(1)=0
      DO 70 IR=1,NR
      IF (KR(IR,1).EQ.0.OR.KR(IR,1).EQ.99) GO TO 70
      MT=ITYPE(IR)
      DO 65 K=1,MT
      I=KR(IR,K)
      DO 30 L=1,MT
      J=KR(IR,L)
      K1=IA(J)
      K2=IA(J+1)-1
      IF (K1.GT.K2) GO TO 15
      DO 10 M=K1,K2
      IF (I.EQ.JA(M)) GO TO 30
   10 CONTINUE
   15 DO 20 M=J,N
   20 IA(M+1)=IA(M+1)+1
      KT=KT+1
      KD=KT-K2
      K2=K2+1
      DO 25 M=1,KD
         KTM = KT-M
         JA(KTM+2) = JA(KTM+1)
   25 CONTINUE
      JA(K2)=I
   30 CONTINUE
      K1=IA(I)
      DO 60 L=4,12
      K2=IA(I+1)-1
      J=KR(IR,L)
      IF (J) 60,65,35
   35 IF (K1.GT.K2) GO TO 45
      DO 40 M=K1,K2
      IF (J.EQ.JA(M)) GO TO 60
   40 CONTINUE
   45 DO 50 M=I,N
   50 IA(M+1)=IA(M+1)+1
      KT=KT+1
      KD=KT-K2
      K2=K2+1
      DO 55 M=1,KD
         KTM = KT-M
         JA(KTM+2) = JA(KTM+1)
   55 CONTINUE
      JA(K2)=J
   60 CONTINUE
   65 CONTINUE
   70 CONTINUE
      DO 80  I=1,N
      K1=IA(I)+1
      K2=IA(I+1)-1
      IF (K1.GT.K2) GO TO 80
      MT=K2-K1+1
      DO 75 K=1,MT
      DO 75 M=K1,K2
      IF (JA(M).GT.JA(M-1)) GO TO 75
      J=JA(M-1)
      JA(M-1)=JA(M)
      JA(M)=J
   75 CONTINUE
   80 CONTINUE
      M=N
      DO 200  I=1,M
      IF(IA(I+1).GT.IA(I)) GO TO 200
      NM=I+1
      NN=N+1
      KMIN=IA(NM)
      KMAX=IA(NN)
      DO 210 J=KMIN,KMAX
      KM=KMAX+KMIN-J
  210 JA(KM)=JA(KM-1)
      KNOW=IA(I)
      JA(KNOW)=I
      DO 220 LL=NM,NN
  220 IA(LL)=IA(LL)+1
  200 CONTINUE
      RETURN
      END
      SUBROUTINE CONVT (NUM,L,N)
C
C  SUBROUTINE CONVT CONVERTS INTEGERS TO ALPHANUMERICS
C     FOR PRINTING
C
C  ASSUMES VALUE OF INTEGER IS POSITIVE
C
      DIMENSION L(5), JDIGIT(10)
C
      DATA JDIGIT/1H0,1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9/
      DATA JBLANK/1H /
C
      NI=NUM
      DO 5 I=1,N
      L(I)=JBLANK
    5 CONTINUE
C
      DO 10 K=1,N
      I=N-K+1
      NEXT=NI/10
      NDX=(NI-NEXT*10)+1
      L(I)=JDIGIT(NDX)
      IF (NEXT.LE.0) GO TO 15
      NI=NEXT
   10 CONTINUE
C
   15 RETURN
      END
      SUBROUTINE VALU (VAL,N,NF,NL)
      COMMON /STORE/ AST(60)
      COMMON /GEAR1/ T,H,HMIN,HMAX,EPS1,UROUND,NC,MF1,KFLAG1,JSTART
      DIMENSION AC(5), AD(5), BC(5)
      INTEGER AC,AD,BC,AST
      DATA IBLK/1H /,IPER/1H./,IZRO/1H0/
      VAL1=ABS(VAL)
      AVAL=ALOG10(VAL1)
      IF (AVAL.EQ.0.) RETURN
      DO 5 I=1,5
      AC(I)=IBLK
      AD(I)=IZRO
    5 BC(I)=IZRO
      IAD=IFIX(AVAL+UROUND)
      IF (IAD) 30,10,10
   10 IREM=3-IAD
      IAD=IAD+1
      JREM=IFIX(VAL1+UROUND)
      REM=VAL1-FLOAT(JREM)
      IF (REM.GT.UROUND.AND.IREM.GT.0) GO TO 15
      CALL CONVT (JREM,AC,5)
      GO TO 50
   15 CALL CONVT (JREM,AD,IAD)
      JREM=IFIX(REM*(10.**IREM)+0.1)
      CALL CONVT (JREM,BC,IREM)
      DO 20 J=1,IAD
   20 AC(J)=AD(J)
      AC(IAD+1)=IPER
      DO 25 K=1,IREM
         KIAD1 = K+IAD+1
      AC(KIAD1)=BC(K)
   25 CONTINUE
      GO TO 40
   30 IAD=IABS(IFIX(AVAL-0.1))-1
      IVAL=IFIX(VAL1*10000.+0.1)
      CALL CONVT (IVAL,AC,5)
      AC(1)=IPER
      DO 35 I=1,IAD
   35 AC(I+1)=IZRO
   40 IF (AC(5).NE.IZRO) GO TO 50
      DO 45 K=1,4
      L=6-K
   45 AC(L)=AC(L-1)
      AC(1)=IBLK
      GO TO 40
   50 DO 55 I=NF,NL
      K=I-NF+1
   55 AST(I)=AC(K)
      RETURN
      END
      SUBROUTINE EMISS (N,H,COEFF)
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C TO HANDLE MORE THAN 16 HISTOGRAM INTERVALS (ASSUMING N IS #INTERVALS)
C THE DIMENSIONED VARIABLES BELOW MUST HAVE THE FOLLOWING DIMENSIONS
C H = N; Y,DYDX = N+1; CF,COEFF = 5*N
C SEE ALSO DIMENSION STATEMENT IN STAIR
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
        DIMENSION H(25), CF(125), Y(26), DYDX(26), COEFF(125)
        DOUBLE PRECISION CF, Y, DYDX, HRATIO, EXPONE, FORRAT, FORCDY
        DOUBLE PRECISION SIGNDY, SMALLV, RATLIM
        REAL DELX, H, COEFF
        INTEGER STARTY, STOPY, INDEX, N, MODE, MODE11
        INTEGER NPLUS1, FIVEN, J, K
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C   N IS THE NUMBER OF HISTOGRAM INTERVALS
C   N + 1  IS THE NUMBER OF EDGES IN THE HISTOGRAM PLOT
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
        RATLIM= 5.001
        MODE=1
        DELX=1.0
        FORRAT= 2.5
        FORCDY = 5.25
        NPLUS1 = N + 1
        FIVEN = 5 * N
        IF ( FIVEN .LE. 1) GO TO 45
        DO 40 J = 1 , FIVEN
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C   SET ALL COEFFICIENTS TO ZERO IN THE CF ARRAY.
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
          CF(J) = 0.0
   40   CONTINUE
   45   CONTINUE
        IF ( NPLUS1 .LE. 1) GO TO 55
        DO 50 J = 1 , NPLUS1
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C  ZERO OUT ALL THE Y'S AND DYDX'S,  IN THE PROCESS
C    FORCING THE EDGE OF THE LAST DELX INTERVAL TO ZERO
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
          Y(J) = 0.0
          DYDX(J) = 0.0
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

```
C  LOOK FOR THE FIRST NON-ZERO H
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
   50   CONTINUE
   55   CONTINUE
        INDEX = 1
C       WHILE ((H(INDEX) .LE. 0.0) .AND. (INDEX .LT. N))
   60   IF ((H(INDEX) .GT. 0.0) .OR. (INDEX .GE. N)) GO TO 65
          INDEX = INDEX + 1
        GO TO 60
   65   CONTINUE
        STARTY = INDEX
        INDEX = INDEX + 1
        MODE1I = 1
C       IF (MODE .NE. 0)
        IF (MODE .EQ. 0) GO TO 70
C        THEN
          MODE1I = STARTY
          Y(STARTY) = H(STARTY)
          DYDX(STARTY) =  0.0
   70   CONTINUE
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C  STAIR DETERMINES THE COEFFICIENTS OF THE FOURTH DEGREE
C  POLYNOMIAL F(X)= (((AX+B)X+C)X+D)X+E SUCH THAT F(X) IS
C  TWICE DIFFERENTIABLE ACROSS HISTOGRAM INTERVAL EDGES,
C  MATCHES IN VALUE AT THE INTERVAL EDGES, AND SUCH THAT
C  THE INTEGRAL OF F(X)DX = THE HISTOGRAM INTERVAL HEIGHT
C  TIMES THE INTERVAL WIDTH (DELX). THE CROSSOVER POINTS
C  (THE VALUES OF F(X) AT THE EDGES BETWEEN TWO HISTOGRAM
C  INTERVALS) ARE THE KNOWNS. STAIR SOLVES FOR THE VALUES
C  OF F'(X) AT THE EDGES GIVEN THE BOUNDARY CONDITIONS OF
C  F'(X) AT THE TWO ENDS OF EACH STAIR EVALUATION. HISFIT
C  STEPS THROUGH THE HISTOGRAM IN ONE PASS, BREAKING THE
C  HISTOGRAM INTO STAIR EVALUATIONS OF 1 OR MORE INTERVALS.
C  NOTE THAT THE CURVE DEFINED BY THE COEFFICIENTS IS ONLY
C  ONCE DIFFERENTIABLE AT EDGES BETWEEN STAIR EVALUATIONS.
C  STAIR EVALUATIONS MAY NOT CROSS POINTS WHERE F'(X) IS
C  KNOWN OR FIXED E.G. ZERO POINTS (DY/DX = 0), OR FORCE
C  FITS (WHERE UNRESTRAINED STAIR FITS RESULT IN FUNCTIONS
C  WITH NEGATIVE VALUES WHICH CORRESPONDS TO NO PHYSICAL
C  REALITY). AT THESE EDGES, THE CURRENT STAIR EVALUATION
C  IS TERMINATED AND A NEW STAIR EVALUATION STARTED. IF
C  THE RATIO OF ADJACENT HISTOGRAM VALUES IS LESS THAN 5/1
C  A CROSSOVER POINT IS PICKED ACCORDING TO THE HEURISTIC:
C         Y =  (RATIO ** 0.50)*(SMALLER VALUE)
C  WHERE 5.001 .GT. RATIO .GT. 1. FOR THE SPECIAL CASE OF A VALUE
C  WHICH HAS A ZERO VALUE TO ONE SIDE, THE OTHER EDGE
C  CROSSOVER IS: Y =  (RATIO ** 0.57)*(SMALLER VALUE)
C  WHERE 5.001 .GT. RATIO .GT. 1. IF THE RATIO OF ADJACENT
```

```
C  HISTOGRAM VALUES EXCEEDS 5 A FIT IS FORCED BY APPROX-
C  IMATING A RATIO-OF-5 FIT THROUGH THE SMALLER VALUE.
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
C       WHILE (INDEX .LE. N)
   90   IF (INDEX .GT. N) GO TO 95
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C  STEP THROUGH HISTOGRAM, BREAK INTO STAIR EVALUATIONS
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
C         IF (H(INDEX) .LE. 0.0)
          IF (H(INDEX) .GT. 0.0) GO TO 100
C          THEN
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C CASE OF NEGATIVE OR ZERO HEIGHT
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
            STOPY = INDEX
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C FIT A SPLINE TO THIS POINT
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
            CALL STAIR(STARTY,STOPY,DELX,H,Y,DYDX,CF)
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C LOOK FOR NEXT NON ZERO H
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
C           WHILE ((H(INDEX) .LE. 0.0) .AND. (INDEX .LT. N))
  120       IF ((H(INDEX) .GT. 0.0) .OR. (INDEX .GE. N))
     1         GO TO 125
              INDEX = INDEX + 1
            GO TO 120
  125       CONTINUE
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C START NEW STAIR EVALUATION
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
            STARTY = INDEX
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C  GOTO BOTTOM OF LOOP
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
            GO TO 105
C
```

```
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C  IT IS GUARANTEED THAT H(INDEX-1) AND H(INDEX) ARE .GT. 0.0
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
 100       CONTINUE
C          ELSE
            HRATIO = H(INDEX) / H(INDEX-1)
            EXPONE= 0.50
C           IF (HRATIO .GE. 1.0)
            IF (HRATIO .LT. 1.0) GO TO 140
C            THEN
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C  BEGIN UP STEP
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
              SIGNDY = 1.0
              SMALLV= H(INDEX-1)
C             IF ((INDEX .EQ. (MODE1I + 1)) .AND. (MODE .EQ. 0))
              IF ((INDEX .NE. (MODE1I + 1)) .OR. (MODE .NE. 0))
     1           GO TO 160
C              THEN
                EXPONE = 0.57
                GO TO 165
 160           CONTINUE
C              ELSE
C               IF .NOT.((INDEX .EQ. 2) .AND. (MODE .NE. 0))
                IF ((INDEX .EQ. 2) .OR. (MODE .NE. 0)) GO TO 170
C                THEN
C                 IF (H(INDEX-2) .EQ. 0.0)
                  IF (H(INDEX-2) .NE. 0.0) GO TO 180
C                  THEN
                    EXPONE = 0.57
 180              CONTINUE
 170            CONTINUE
 165          CONTINUE
              GO TO 185
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C  END UP STEP
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
 140         CONTINUE
C            ELSE
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C  BEGIN DOWN STEP
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
              HRATIO = 1.0 / HRATIO
              SIGNDY = -1.0
              SMALLV= H(INDEX)
C             IF (INDEX .EQ. N)
              IF (INDEX .NE. N) GO TO 190
C              THEN
                EXPONE = 0.57
                GO TO 195
  190          CONTINUE
C              ELSE
C               IF (H(INDEX+1) .EQ. 0.0)
                IF (H(INDEX+1) .NE. 0.0) GO TO 200
C                THEN
                  EXPONE = 0.57
  200           CONTINUE
  195         CONTINUE
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C  END DOWN STEP
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
  185       CONTINUE
C           IF (HRATIO .LT. RATLIM)
            IF (HRATIO .GE. RATLIM) GO TO 205
C            THEN
              Y(INDEX) = (HRATIO ** EXPONE) * SMALLV
              GO TO 210
C            ELSE
  205        CONTINUE
              Y(INDEX) = FORRAT * SMALLV
              DYDX(INDEX) = SIGNDY * FORCDY * (Y(INDEX) / DELX)
              STOPY = INDEX
              CALL STAIR(STARTY,STOPY,DELX,H,Y,DYDX,CF)
              STARTY = INDEX
  210       CONTINUE
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C  BOTTOM OF LOOP, EXAMINE NEXT INTERVAL
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
  105     CONTINUE
          INDEX = INDEX + 1
        GO TO 90
   95   CONTINUE
C       ENDWHILE (INDEX .LE. N) LOOP
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C  FOR THE FINAL SPLINE PORTION, CALL STAIR.
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
C       IF (STARTY .NE. (N+1)) .AND. (H(N) .NE. 0.0)
```

```
        IF ((STARTY .EQ. (N+1)) .OR. (H(N) .EQ. 0.0))
     1     GO TO 220
C        THEN
          STOPY = N + 1
          CALL STAIR(STARTY,STOPY,DELX,H,Y,DYDX,CF)
  220   CONTINUE
        IF (1 .GT. FIVEN) GO TO 255
        DO 260 K = 1 , FIVEN
          COEFF(K) = CF(K)
  260   CONTINUE
  255   CONTINUE
      RETURN
      END
      SUBROUTINE STAIR(KSTRT,KSTOP,DELX,H,Y,DYDX,CF)
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C TO HANDLE MORE THAN 16 HISTOGRAM INTERVALS (ASSUMING N IS #INTERVALS)
C THE DIMENSIONED VARIABLES BELOW MUST HAVE THE FOLLOWING DIMENSIONS
C H = N; Y,DYDX,A,B,C = N+1; CF = 5*N
C SEE ALSO DIMENSION STATEMENT IN HISFIT
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
        DIMENSION A(26), B(26), C(26), CF(125), Y(26), DYDX(26), H(25)
        DOUBLE PRECISION A, B, C, R, S1, S2, T1, T2, U1, U2, V1, V2, Z
        DOUBLE PRECISION Y, DYDX, CF
        REAL DELX, H
        INTEGER K,KSTRT,KSTOP,KSTOP1, J1, J2
        INTEGER KSTOP2, KDOWN, KSTRT1
        KSTOP1 = KSTOP - 1
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C  COMPUTE COEFFICIENTS FOR
C    FK(X)=AK(X-XK)4 + BK(X-XK)3 + CK(X-XK)2 + DK(X-XK) +EK
C
C  STORE IN ARRAY CF AS:
C    CF 5*K =A;        CF 5*K-1 =B;       CF 5*K-2 =C;
C    CF 5*K-3 =D=YKP                      CF 5*K-4 =E=YK
C    CF 5*K-3 =D=YKP                      CF 5*K-4 =E=YK
C     FOR K=KSTRT TO KSTOP  (WHERE KSTOP-KSTRT IS THE NUMBER
C                                 OF INTERVALS. )
C   KSTRT  IS THE LEFT EDGE OF THE STARTING HISTOGRAM BAR
C   KSTOP  IS THE RIGHT EDGE OF THE STOPPING HISTOGRAM BAR
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
        IF (KSTRT .GT. KSTOP1) GO TO 300
        DO 295 K = KSTRT , KSTOP1
          CF(5*K-4)=Y(K)
  295   CONTINUE
  300   CONTINUE
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C SET UP AND SOLVE MATRIX
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
        B(KSTRT)=0.0
        C(KSTRT)=0.0
        IF ( KSTRT .GT. KSTOP1) GO TO 310
        DO 305 K = KSTRT , KSTOP1
          J2=K+1
          U2=1.0/(DELX)
          A(K)=U2
          V2=U2*U2
          S2=20.0*V2*H(K)
```

```
         T2=8.0*V2*(Y(K)+Y(J2))
C        IF (K.GT.KSTRT)
         IF (K.LE.KSTRT) GO TO 315
C         THEN
          Z=1.0/(3.0*(U1+U2)+U1*B(J1))
          B(K)= -U2*Z
          R=S2-S1-T2+T1+4.0*(V1-V2)*Y(K)
C          IF (K.EQ.KSTRT+1)
           IF (K.NE.KSTRT+1) GO TO 335
C           THEN
            R=R+U1*DYDX(KSTRT)
 335       CONTINUE
C          IF (K.EQ.KSTOP1)
           IF (K.NE.KSTOP1) GO TO 345
C           THEN
             R=R+U1*DYDX(KSTOP)
 345       CONTINUE
           C(K)=Z*(R+U1*C(J1))
 315     CONTINUE
         J1=K
         U1=U2
         V1=V2
         S1=S2
         T1=T2
 305   CONTINUE
 310   CONTINUE
C
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C  BACK SUBSTITUTION
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
C      IF (KSTOP-KSTRT.GT.1)
       IF (KSTOP-KSTRT.LE.1) GO TO 355
C       THEN
         DYDX(KSTOP-1)=C(KSTOP-1)
         KSTOPP=KSTOP-1
         CF(5*KSTOPP-3)=DYDX(KSTOPP)
C        IF (KSTOP-KSTRT.GT.2)
         IF (KSTOP-KSTRT.LE.2) GO TO 375
C         THEN
           KSTOP2 = KSTOP - 2
           KSTRT1 = KSTRT + 1
           DO 380 K = KSTRT1 , KSTOP2
             KDOWN = KSTRT1 + KSTOP2 - K
             DYDX(KDOWN) = C(KDOWN) - B(KDOWN) * DYDX(KDOWN+1)
             CF(5*KDOWN-3) = DYDX(KDOWN)
 380       CONTINUE
 375     CONTINUE
```

```
  355   CONTINUE
        CF(5*KSTRT-3)=DYDX(KSTRT)
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C COMPUTE 2ND, 3RD, 4TH ORDER COEFFICIENTS
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
        IF ( KSTRT .GT. KSTOP1) GO TO 400
        DO 395 K = KSTRT , KSTOP1
          J2=K+1
          Z=A(K)
          CF(5*K-2)= 1.5*Z*(-3.0*DYDX(K) + DYDX(J2) + Z*(-8.0*
     1    Y(J2) - 12.0*Y(K) + 20.0*H(K)))
          CF(5*K-1)= -4.0*Z*Z*(-1.5*DYDX(K) + DYDX(J2) + Z*(-7.0*
     1    Y(J2) - 8.0*Y(K) +15.0*H(K)))
          CF(5*K) = 5.0*Z*Z*Z*(0.5*(DYDX(J2)-DYDX(K)) - 3.0*Z*
     1    (Y(J2) + Y(K) - 2.0*H(K)))
  395   CONTINUE
  400   CONTINUE
      RETURN
      END
      SUBROUTINE PHOT (PLACE)
C
C    ****    RATE CONSTANT CALCULATIONS FOR FIRST ORDER PHOTOCHEMICAL RE
C
      COMMON /SUNLIT/ Z(10),RTCON(10),
     1LAM1,INC,SLA,SLO,TZ,IY,IM,ID,ISTRT,ISTOP,IINC,IEND,SPECIE,MAXZ,ITI
     2ME(24),XZ(24),K(24),JSTRT,JSTOP,SPEC,MNLM,MXLM,MAXL,MAXJ
      COMMON /PHOTON/ CF(72,20),P(24,20),IPH(20),IP,RFCT(20),PP(10,20)
      INTEGER SPEC
      DIMENSION D(2), C(72), W(72), V(5), TMS(25), PLACE(6)
      DATA D/0.,0./
C
      IEND=24
      NTM=IEND
      TIME=JSTRT
      DO 5 II=1,IEND
C
C    ****    CALL SUBROUTINE TO COMPUTE ZENITH ANGLES FROM TIME OF DAY
C
      XC=0.0
      TSTD=TIME-100.
      IF (TSTD.LT.0.) TSTD=TSTD+2400.
      CALL SOLAR (SLA,SLO,TZ,IY,IM,ID,TSTD,XC,5)
      ITIME(II)=TIME
      XZ(II)=90.-XC
      TIME=CLOCK(TIME,IINC)
C
      IF (TIME.GT.2400.) TIME=TIME-2400.
    5 CONTINUE
C
      DO 20 L=1,IP
      ISTRT=(MNLM-LAM1)/INC+1
      ISTOP=(MXLM-LAM1)/INC+1
C
C    ****    CALL FIRST SUBROUTINE FOR SPLINE INTERPOLATION OF RATE CONS
C
      IF (L.EQ.1) CALL SPLNA (MAXZ,Z,RTCON,2,D,C,W)
      IF (L.GT.1) CALL SPLNA (10,Z,PP(1,L),2,D,C,W)
      DO 15 II=1,IEND
      V(1)=XZ(II)
      P(II,L)=0.
      IF (V(1).GT.90.0) GO TO 15
C
C    ****    CALL SECOND SUBROUTINE IN SPLINE INTERPOLATION SCHEME
C
      IF (L.EQ.1) CALL SPLNB (MAXZ,Z,RTCON,C,V)
      IF (L.GT.1) CALL SPLNB (10,Z,PP(1,L),C,V)
      P(II,L)=AMAX1(0.0,V(2))
   15 CONTINUE
C
```

```
   20 CONTINUE
C     DETERMINE TIME OF SOLAR NOON
C
      IZMN=IEND
      XZEM=9999.
      DO 25 I=1,IEND
      IF (XZ(I).GE.XZEM) GO TO 25
      XZEM=XZ(I)
      IZMN=I
   25 CONTINUE
      I=IZMN
   30 TIME=ITIME(I-1)
      XA=XZ(I-1)
      DO 35 I=1,60
      SPECIE=TIME
      TIME=CLOCK(TIME,1)
      TSTD=TIME-100.
      IF (TSTD.LT.0.) TSTD=TSTD+2400.
      XB=XA
      CALL SOLAR (SLA,SLO,TZ,IY,IM,ID,TSTD,XC,5)
      XA=90.-XC
      IF (XA.GT.XB) GO TO 40
   35 CONTINUE
   40 DO 45 I=1,IEND
      TMS(I)=60.*FLOAT(I-1)
   45 CONTINUE
      DO 55 L=1,IP
      DO 50 I=2,IEND
      NMM=IEND+2-I
      IF (P(NMM-1,L).GT.0.) GO TO 55
   50 CONTINUE
   55 CALL SPLNA (NMM,TMS,P(1,L),2,D,CF(1,L),W)
      RETURN
      END
      SUBROUTINE SOLAR (SLA,SLO,TZ,IY,IM,ID,TIME,D,NV)
C***
C***     SLA...  LATITUDE (DEG)  SOUTH = MINUS
C***     SLO...  LONGITUDE (DEG)  EAST = MINUS
C***     TZ...  TIME ZONE
C***            ALSO INCLUDES FRACTION IF LOCAL TIME IS NOT
C***             STANDARD MERIDIAN TIME.  E.G. POONA, INDIA 5.5
C***     IY..  YEAR
C***     IM..  MONTH
C***     ID..  DAY
C***     TIME.. LOCAL STANDARD TIME IN HOURS AND MINUTES.
C***            1 30 PM = 1330  ** STANDARD TIME **
C***     D..  RETURNED VALUE
C***     NV..  VALUE TO BE RETURNED, SELECTED AS FOLLOWS....
C***           1...  DECLINATION (DEG.)
C***           2...  EQUATION OF TIME ADJUSTMENT (HRS.)
C***           3...  TRUE SOLAR TIME (HRS.)
C***           4...  HOUR ANGLE (DEG.)
C***           5...  SOLAR ELEVATION (DEG.)
C***           6...  OPTICAL AIRMASS
C***     0 ( NV ( 7.  OTHERWISE, D = 9999.
C***
      DIMENSION MD(11)
      DATA MD/31,29,31,30,31,30,2*31,30,31,30/
      DATA A,B,C,SIGA/0.15,3.885,1.253,279.9348/
      RAD=572957.75913E-4
      SDEC=39784.988432E-5
      RE=1.
      IF (SLO.LT.0.) RE=-1.
      KZ=TZ
      TC=(TZ-FLOAT(KZ))*RE
      TZZ=FLOAT(KZ)*RE
      SLB=SLA/RAD
      K=ID
      TIMH=TIME/100.
      I=TIMH
      TIMLOC=(TIMH-FLOAT(I))/0.6+FLOAT(I)+TC
      IMC=IM-1
      IF (IMC.LT.1) GO TO 10
      DO 5 I=1,IMC
    5 K=K+MD(I)
   10 LEAP=1
      NL=MOD(IY,4)
      IF (NL.LT.1) LEAP=2
      SMER=TZZ*15.
      TK=((SMER-SLO)*4.)/60.
      KR=1
      IF (K.GE.61.AND.LEAP.LT.2) KR=2
      DAD=(TIMLOC+TZZ)/24.
      DAD=DAD+FLOAT(K-KR)
      DF=DAD*360./365.242
      DE=DF/RAD
      DESIN=SIN(DE)
      DECOS=COS(DE)
      DESIN2=SIN(DE*2.)
      DECOS2=COS(DE*2.)
      SIG=SIGA+DF+1.914827*DESIN-0.079525*DECOS+0.019938*DESIN2-0.00162*
     1DECOS2
      SIG=SIG/RAD
      DECSIN=SDEC*SIN(SIG)
      EFFDEC=ASIN(DECSIN)
      IF (NV.NE.1) GO TO 15
      D=EFFDEC*RAD
      RETURN
   15 EQT=0.12357*DESIN-0.004289*DECOS+0.153809*DESIN2+0.060783*DECOS2
      IF (NV.NE.2) GO TO 20
      D=EQT
      RETURN
   20 TST=TK+TIMLOC-EQT
      IF (NV.NE.3) GO TO 25
      D=TST
      IF (D.LT.0.) D=D+24.
      IF (D.GE.24.) D=D-24.
      RETURN
   25 HRANGL=ABS(TST-12.)*15.
      IF (NV.NE.4) GO TO 30
      D=HRANGL
      RETURN
   30 HRANGL=HRANGL/RAD
      SOLSIN=DECSIN*SIN(SLB)+COS(EFFDEC)*COS(SLB)*COS(HRANGL)
      SOLEL=ASIN(SOLSIN)*RAD
      IF (NV.NE.5) GO TO 35
      D=SOLEL
      RETURN
   35 IF (NV.NE.6) GO TO 40
      IF (SOLEL.LE.0.) GO TO 40
      TK=SOLEL+B
      E=1./TK**C
      D=1./(A*E+SOLSIN)
      RETURN
   40 D=9999.
      RETURN
      END
      SUBROUTINE SPLNA (N,X,Y,J,D,C,W)
      DIMENSION X(24), Y(24), D(2), C(72), W(72)
C     ------------------------------------------------------------------
C             OVER THE INTERVAL X(I) TO X(I+1), THE INTERPOLATING
C             POLYNOMIAL
C                  Y=Y(I)+A(I)*Z+B(I)*Z**2+E(I)*Z**3
C             WHERE Z=(X-X(I))/(X(I+1)-X(I))
C             IS USED. THE COEFFICIENTS A(I),B(I) AND E(I) ARE COMPUTED
C             BY SPLNA AND STORED IN LOCATIONS C(3*I-2),C(3*I-1) AND
C             C(3*I) RESPECTIVELY.
C             WHILE WORKING IN THE ITH INTERVAL,THE VARIABLE Q WILL
C             REPRESENT Q=X(I+1) - X(I), AND Y(I) WILL REPRESENT
C             Y(I+1)-Y(I)
C     ------------------------------------------------------------------
C
      Q=X(2)-X(1)
      YI=Y(2)-Y(1)
      IF (J.EQ.2) GO TO 5
C     ------------------------------------------------------------------
C             IF THE FIRST DERIVATIVE AT THE END POINTS IS GIVEN,
C             A(1) IS KNOWN, AND THE SECOND EQUATION BECOMES
C             MERELY B(1)+E(1)=YI - Q*D(1).
C     ------------------------------------------------------------------
      C(1)=Q*D(1)
      C(2)=1.0
      W(2)=YI-C(1)
      GO TO 10
C     ------------------------------------------------------------------
C             IF THE SECOND DERIVATIVE AT THE END POINTS IS GIVEN
C             B(1) IS KNOWN, THE SECOND EQUATION BECOMES
C             A(1)+E(1)=YI-0.5*Q*Q*D(1). DURING THE SOLUTION OF
C             THE 3N-4 EQUATIONS,A1 WILL BE KEPT IN CELL C(2)
C             INSTEAD OF C(1) TO RETAIN THE TRIDIAGONAL FORM OF THE
C             COEFFICIENT MATRIX.
C     ------------------------------------------------------------------
    5 C(2)=0.0
      W(2)=0.5*Q*Q*D(1)
   10 M=N-2
      IF (M.LE.0) GO TO 20
C     ------------------------------------------------------------------
C             UPPER TRIANGULARIZATION OF THE TRIDIAGONAL SYSTEM OF
C             EQUATIONS FOR THE COEFFICIENT MATRIX FOLLOWS--
C     ------------------------------------------------------------------
      DO 15 I=1,M
      AI=Q
      Q=X(I+2)-X(I+1)
      H=AI/Q
      C(3*I)=-H/(2.0-C(3*I-1))
      W(3*I)=(-YI-W(3*I-1))/(2.0-C(3*I-1))
      C(3*I+1)=-H*H/(H-C(3*I))
      W(3*I+1)=(YI-W(3*I))/(H-C(3*I))
      YI=Y(I+2)-Y(I+1)
      C(3*I+2)=1.0/(1.0-C(3*I+1))
   15 W(3*I+2)=(YI-W(3*I+1))/(1.0-C(3*I+1))
C     ------------------------------------------------------------------
C               E(N-1) IS DETERMINED DIRECTLY FROM THE LAST EQUATION
C               OBTAINED ABOVE, AND THE FIRST OR SECOND DERIVATIVE
C               VALUE GIVEN AT THE END POINT.
C     ------------------------------------------------------------------
   20 IF (J.EQ.1) GO TO 25
      C(3*N-3)=(Q*Q*D(2)/2.0-W(3*N-4))/(3.0-C(3*N-4))
      GO TO 30
   25 C(3*N-3)=(Q*D(2)-YI-W(3*N-4))/(2.0-C(3*N-4))
   30 M=3*N-6
      IF (M.LE.0) GO TO 40
C     ------------------------------------------------------------------
C               BACK SOLUTION FOR ALL COEFFICENTS EXCEPT
C               A(1) AND B(1) FOLLOWS--
C     ------------------------------------------------------------------
      DO 35 II=1,M
      I=M-II+3
   35 C(I)=W(I)-C(I)*C(I+1)
   40 IF (J.EQ.1) GO TO 45
C     ------------------------------------------------------------------
C               IF THE SECOND DERIVATIVE IS GIVEN AT THE END POINTS,
C               A(1) CAN NOW BE COMPUTED FROM THE KNOWN VALUES OF
C               B(1) AND E(1). THEN A(1) AND B(1) ARE PUT INTO THEIR
C               PROPER PLACES IN THE C ARRAY.
C     ------------------------------------------------------------------
      C(1)=Y(2)-Y(1)-W(2)-C(3)
      C(2)=W(2)
      RETURN
   45 C(2)=W(2)-C(3)
      RETURN
      END
      SUBROUTINE SPLNB (N,X,Y,C,V)
      DIMENSION X(24), Y(24), C(72), V(5)
      V(5)=2.0
      LIM=N-1
C                    ---------------------------------------------------
C                    DETERMINE IN WHICH INTERVAL THE INDEPENDENT
C                    VARIABLE,V(1),LIES.
C                    ---------------------------------------------------
      DO 5 I=2,LIM
      IF (V(1).LT.X(I)) GO TO 10
    5 CONTINUE
      I=N
      IF (V(1).GT.X(N)) V(5)=3.0
      GO TO 15
   10 IF (V(1).LT.X(1)) V(5)=1.0
C                    ---------------------------------------------------
C                    Q IS THE SIZE OF THE INTERVAL CONTAINING V(1).
C                    ---------------------------------------------------
C                    Z IS A LINEAR TRANSFORMATION OF THE INTERVAL
C                    ONTO (0,1) AND IS THE VARIABLE FOR WHICH
C                    THE COEFFICIENTS WERE COMPUTED BY SPLNA.
C                    ---------------------------------------------------
   15 Q=X(I)-X(I-1)
      Z=(V(1)-X(I-1))/Q
      V(2)=((Z*C(3*I-3)+C(3*I-4))*Z+C(3*I-5))*Z+Y(I-1)
      V(3)=((3.*Z*C(3*I-3)+2.0*C(3*I-4))*Z+C(3*I-5))/Q
      V(4)=(6.*Z*C(3*I-3)+2.0*C(3*I-4))/(Q*Q)
      RETURN
      END
      FUNCTION CLOCK (T1,IINC)
C
C    ****    ADD A TIME IN MINUTES TO A 2400 HOUR TIME AND RETURN A 2400
C    ****    HOUR TIME
C
      T2=IINC
      I100=INT(T1/100.)
      T3=T1-100.0*FLOAT(I100)+T2
      I100=I100+INT(T3/60.)
      CLOCK=FLOAT(I100)*100.0+T3-60.0*FLOAT(INT(T3/60.0))
      RETURN
      END
      SUBROUTINE SUNTIM
C
C    FIND SUNRISE AND SUNSET VALUES
C
      COMMON /SUNLIT/ Z(10),RTCON(10),
     1LAM1,INC,SLA,SLO,TZ,IY,IM,ID,ISTRT,ISTOP,IINC,IEND,SPECIE,MAXZ,ITI
     2ME(24),XZ(24),KJ(24),JSTRT,JSTOP,PSPEC,MNLM,MXLM,MAXL,MAXJ
      COMMON /MIXING/ DSTRT,DEND,AMC(5),BMC(5),CMC(5),FD(6),FG(6),
     1AMXX(26),DL,TTMAX,SSRISE,SRMIN,DELH,TDIL,NMXX,HEIGHT,SSET,SRISE
      INTEGER PSPEC
C
C   FIND SUNRISE
C
      T=0.
    5 CALL SOLAR(SLA,SLO,TZ,IY,IM,ID,T,D,5)
      IF (D.GE.0.000001) GO TO 10
      T=CLOCK(T,60)
      GO TO 5
C
C   FIND HALF HOUR VALUE
C
   10 T=T-70.
      CALL SOLAR(SLA,SLO,TZ,IY,IM,ID,T,D,5)
      IF (D.GE.0.000001) GO TO 20
C
   15 T=CLOCK(T,1)
      CALL SOLAR(SLA,SLO,TZ,IY,IM,ID,T,D,5)
      IF (D.GE.0.000001) GO TO 25
      GO TO 15
C
   20 T=T-30.
  200 T=CLOCK(T,1)
      CALL SOLAR(SLA,SLO,TZ,IY,IM,ID,T,D,5)
      IF (D.LT.0.000001) GO TO 25
      GO TO 200
C
   25 SRISE=CLOCK(T,60)
C
C   FIND SUNSET
C
      T=1200.
   30 CALL SOLAR(SLA,SLO,TZ,IY,IM,ID,T,D,5)
      IF (D.LT.0.000001) GO TO 35
      T=CLOCK(T,60)
      GO TO 30
C
C   FIND HALF HOUR VALUE
C
   35 T=T-70.
      CALL SOLAR(SLA,SLO,TZ,IY,IM,ID,T,D,5)
      IF (D.LT.0.000001) GO TO 45
C
   40 T=CLOCK(T,1)
      CALL SOLAR(SLA,SLO,TZ,IY,IM,ID,T,D,5)
      IF (D.LT.0.000001) GO TO 50
      GO TO 40
C
   45 T=T-30.
  450 T=CLOCK(T,1)
      CALL SOLAR(SLA,SLO,TZ,IY,IM,ID,T,D,5)
      IF (D.GE.0.000001) GO TO 50
      GO TO 450
C
   50 SSET=CLOCK(T,60)
C
      RETURN
      END
      SUBROUTINE EKCALC (X)
C
C     THIS SUBROUTINE PERFORMS VOC CONTROL REQUIREMENTS AS OUTLINED
C   IN THE 1981 EPA GUIDELINES ON THE USE OF CITY-SPECIFIC EKMA.  THIS
C   ROUTINE ALSO INCLUDES PROCEDURES DESCRIBED IN APPENDIX B OF THE
C   1981 GUIDELINES.
C
      COMMON /CALC/ NR,KR(200,12),A(200),S(200),R(200),ITYPE(200),IA(90)
     1,JA(1500),DILUT,TEMP,ERR,START,STOPP,SPECIS(91),TPRNT,TSTEP,ZENI
      COMMON /CNTRL/ SIG,SIGMA,INFO,NPTO,TSRT,DTIM,Z1,Z2,DCON,EHC,EXN,FL
     1ST,TLST
      COMMON /SPEC/ NS,HCSPEC(15),CARB(15),RCTY(15),XNF(2),IH(15),
     1INOX(2),FINHC(15),FALHC(15),NHC,OZIN,OZAL,HCIN,HCAL,XNIN,XNAL,
     2NOZ,FENX(2),C(91),REACT(91),NI,PLSP(5),KOZ(5)
      COMMON /SUNLIT/ Z(10),RTCON(10),
     1LAM1,INC,SLA,SLO,TZ,IY,IM,ID,ISTRT,ISTOP,IINC,IEND,SPECIE,MAXZ,ITI
     2ME(24),XZ(24),KKK(24),JSTRT,JSTOP,PSPEC,MNLM,MXLM,MAXL,MAXJ
      COMMON /PHOTON/ CF(72,20),P(24,20),IPH(20),IP,RFCT(20),PP(10,20)
      COMMON /ZENITH/ IPZ,ZDEF(10,20),IPHZ(20),IZENP
      COMMON /EMIS/ NEM,ISP,ESTRT(5),ESTOP,ESLP,EMSP(5),IEMLS(5),EOSLP(5
     1),EMO(26,5),ECI(5),EM(26),EC(125),ECO(125,5)
      COMMON /MIX/ NMIX,AMIX(26),STRM,STOPM,DC(104)
      COMMON /MIXING/ DSTRT,DEND,AMC(5),BMC(5),CMC(5),FD(6),FG(6),
     1 AMXX(26),DL,TTMAX,SSRISE,SRMIN,DELH,TDIL,NMXX,HEIGHT,SSET,SRISE
      COMMON /TEMPER/ TEMEND,NTEMP,QM(30)
      COMMON /FRPLOT/ SAVCON(80,5),SAVTIM(80),NTSV,INOW
      COMMON /INOUT/ IN,IOUT,ITAPE,IALN,IALL,INHH
      COMMON /TITL/ ITTL(36)
      COMMON /NEED/ HC,XN,NL,NRTO,RTO(20),OZP(20),OZN(8,20),RHO(8,20),MR
     1,OC(4),OS(2),HCS,XNS,LS,HCLL(8),XNLL(8)
      COMMON /HEAT/ SC(200,12),ISC(200,3)
      COMMON /NEED1/ IBLANK,MBLANK,IIHC,IINX,IICO,IINO2,IINO,IIO3,
     1IIH2O,IBZA,JPLUS
      COMMON /STORE/ AST(60)
      COMMON /HOUR/ OZM(5),NGO,TTM,TM(5)
      COMMON /PLTVEC/ HCT(20),OT(20),NT,OHC,HCG,PLTGRD,OXN,XNG,HC1,XN1,T
     1ICZ,DIGZ,CHRZ
      COMMON /ALOFT/ IALFT,CALFT(10),LOCALF(10),ISPAL(10)
      COMMON /DEPOS/ IDEPO,RDEPO(26,10),LOCDEP(10),ISPDP(10),RDCOEF(125,
     110),IDPTIM,DPEND,RDEP1(26,10),DNOWS
      COMMON /VVLB1/ FCTR,DIST,CHRSIZ,NNCHR,OZBL
      COMMON /BK1/ FBK(10),FBKAL(5),HCBK,XNBK,OZBK
      DIMENSION X(7)
C
      FOZS = 0.0
      FOZA = 0.0
      FOCS = 0.0
      FOCA = 0.0
      FXNS = 0.0
      FXNA = 0.0
      CFHC = 0.0
      CFNOX = 0.0
      NPTO=0
      INFO=-1
      DOZ = 0.12
      AOZ=0.12
      HCTNOX=1.
      NTRYS = 8
      ACCU = 0.005
      RNMOC=0.60
      BNMOC = HCBK
      IF (ABS(X(1)) .NE. 0.0) DOZ = ABS(X(1))
      IF (ABS(X(2)) .NE. 0.0) HCTNOX = ABS(X(2))
      IF (X(4) .GT. 0.0) READ (IN,300) FOZS,FOZA,FOCS,FOCA,FXNS,FXNA,
     1  HCLV
      REDNOX = 1.0 + X(3)*.01
C
C
C  DO SOME PRELIMINARY CALCULATIONS
C
      OZINSV=OZIN
      OZALSV=OZAL
      HCINSV=HCIN
      HCALSV=HCAL
      XNINSV = XNIN
      XNALSV=XNAL
C
      REDNX1=X(3)
C
C  ESTIMATE FUTURE NMOC IF NOT GIVEN
C
      RNMOC1=FOCA
      IF (FOCA.GE.0.) GO TO 517
      IF (FOCA.GT.(-99.)) RNMOC=ABS(FOCA)*0.01
      RNMOC1 = (HCALSV - BNMOC)*RNMOC + BNMOC
C
C  ESTIMATE FUTURE NMOC IN THE SURFACE LAYER
C
  517 RNMOC2 = (HCINSV - BNMOC)*RNMOC + BNMOC
      IF (FOCS.GE.0.) RNMOC2=FOCS
      IF (FOCS.LT.(-0.00001)) CFHC=ABS(FOCS)
      IF (FXNS.LT.(-0.00001)) CFNOX=ABS(FXNS)
      CHCNOX = HCTNOX*(1.-CFHC)/(1.-CFNOX)
      ROZ1=FOZA
      IF (FOZA.GE.0.) GO TO 533
C
C  USE THE OZONE TRANSPORT CURVES TO ESTIMATE FUTURE OZONE IF
C  FUTURE OZONE IS NEGATIVE (SEE 1981 CITY-SPECIFIC GUIDELINES P. 54)
C
      ROZ1=OZALSV
      IF (OZALSV .LE. 0.05) GO TO 533
C
C  IF INPUTED FUTURE OZONE VALUE IS LESS -100. THEN USE
C    DASH LINE OF OZONE CURVE
C
      IF (FOZA.LT.(-99.)) GO TO 532
      ROZ1 = 0.5833333*OZALSV + 0.020833333
      IF (OZALSV .GT. 0.17) ROZ1 = 0.12
      GO TO 533
  532 ROZ1 = 0.77777778*OZALSV + 0.011111111
      IF (OZALSV .GT. 0.14) ROZ1 = 0.12
C
C  REPEAT FUTURE OZONE ESTIMATE FOR SURFACE LAYER
C
  533 ROZ2=FOZS
      IF (FOZS.GE.0.) GO TO 535
      ROZ2=OZINSV
      IF (OZINSV .LE. 0.05) GO TO 535
      IF (FOZS.LT.(-99.))  GO TO 534
      ROZ2 = 0.5833333*OZINSV + 0.020833333
      IF (OZINSV .GT. 0.17) ROZ2 = 0.12
      GO TO 535
  534 ROZ2 = 0.77777778*OZINSV + 0.011111111
      IF (OZINSV .GT. 0.14) ROZ2 = 0.12
C
  535 HC1 = -99.0
      HC2 = 1.0
      OXN2 = HC2/HCTNOX
C
      WRITE (IOUT,501) DOZ,HCTNOX,REDNX1,ROZ1,RNMOC1,FXNA
      IF (CFHC.GT.0..OR.CFNOX.GT.0.) WRITE (IOUT,547) CFHC,CFNOX,
     1CHCNOX
      WRITE (IOUT,548) ROZ2,RNMOC2,FXNS,PLSP(1)
C
C  IF BASE YEAR PRECURSOR TRANSPORT IS LESS THAN BACKGROUND
C   THEN SKIP APPENDIX B PROCEDURES
C
      IF (HCIN .LE. HCBK) GO TO 519
      IF (CFHC.LE.0..AND.CFNOX.LE.0.) GO TO 519
C
C  DO APPENDIX B (STEP 3)
C
      HCIN = 0.0
      DO 512 I=1, NTRYS
         CALL SIM (HC2,OXN2,ZN2,10)
         DIFF = ABS(ZN2-DOZ)/DOZ
         IF (DIFF .LE. ACCU) GO TO 518
         IF (HC1 .NE. (-99.0)) GO TO 510
      HC1=HC2
      ZN1=ZN2
      HC2=HC1*DOZ/ZN2
      OXN2=HC2/HCTNOX
      GO TO 512
  510 B=(DOZ-ZN1)*(HC2-HC1)/(ZN2-ZN1)+HC1
C
C     CHECK FOR REVERSING TREND. FIX SO WE DO NOT LOOP
C
      IF (ZN2.GT.ZN1 .AND. HC2.LT.HC1 .AND. ZN2.GT.DOZ)
     1    B = DOZ*HC2/ZN2
      IF (B.LT.0.) B=HC2/2.0
      HC1=HC2
      ZN1=ZN2
      HC2=B
      OXN2=HC2/HCTNOX
  512 CONTINUE
      GO TO 523
C
C  DO STEPS 4, 5, AND 6 (APPENDIX B)
C
  518 HCIN = HC2*CFHC
      XNIN = OXN2*CFNOX
      HCTNOX = CHCNOX
      RNMOC2 = (HCIN - BNMOC)*RNMOC + BNMOC
      HC2 = OXN2*HCTNOX
      IF (CFHC.LE.0..AND.CFNOX.LE.0.) GO TO 519
      DO 614 J=1,ISP
      IF (EMSP(J).NE.IIHC.AND.EMSP(J).NE.IINX) GO TO 614
      IF (EMSP(J).EQ.IIHC) CFX=CFHC
      IF (EMSP(J).EQ.IINX) CFX=CFNOX
      DO 613 I=1,IEM
      EM(I)=EMO(I,J)/(1.-CFX)
  613 CONTINUE
      CALL EMISS(IEM,EM,ECO(1,J))
  614 CONTINUE
C
C  NOW DO BASE CASE CALCULATION
C
  519 DO 522 I=1, NTRYS
         CALL SIM (HC2,OXN2,ZN2,10)
         DIFF = ABS(ZN2-DOZ)/DOZ
         IF (DIFF .LE. ACCU) GO TO 526
         IF (HC1 .NE. (-99.0)) GO TO 520
      HC1=HC2
      ZN1=ZN2
      HC2=HC1*DOZ/ZN2
      OXN2=HC2/HCTNOX
      GO TO 522
  520 B=(DOZ-ZN1)*(HC2-HC1)/(ZN2-ZN1)+HC1
C
C     CHECK FOR REVERSING TREND. FIX SO WE DO NOT LOOP
```

```
C
      IF (ZN2.GT.ZN1 .AND. HC2.LT.HC1 .AND. ZN2.GT.DOZ)
     1    B = DOZ*HC2/ZN2
      IF (B.LT.0.) B=HC2/2.0
      HC1=HC2
      ZN1=ZN2
      HC2=B
      OXN2=HC2/HCTNOX
  522 CONTINUE
C
C     WAS NOT ABLE TO FIND DESIGN OZONE WITHIN ALLOTTED TRYS
C
  523 WRITE (IOUT,524) DOZ,NTRYS,HC1,OXN1,ZN1
      GO TO 544
C
C     FOUND IT.   NOW DO FUTURE YEAR CALCULATION
C
  526 OXN1 = OXN2*REDNOX
      HCORG = HC2
      IF (X(6).LT.(-0.000001)) GO TO 544
      HCAL=RNMOC1
      HCIN=RNMOC2
      OZAL=ROZ1
      OZIN=ROZ2
      IF (FOCS.GT.(-0.00001)) HCIN=FOCS
      IF (FXNS.GE.(-0.00001)) XNIN=FXNS
      IF (FXNA.GE.(-0.00001)) XNAL=FXNA
C
C  TAKE AN INITIAL GUESS AT VOC REDUCTION (50 PERCENT)
C
      HC1=0.5*HC2
      HC2 = 0.0
      ZN2 = 0.0
      OXN2 = OXN1
C
      DO 540 I=1, NTRYS
         CALL SIM (HC1,OXN1,ZN1,10)
         DIFF = ABS(ZN1-AOZ)/AOZ
         IF (DIFF .LE. ACCU) GO TO 542
         DELTA = 1.0
         IF (ZN1 .NE. ZN2) DELTA = (HC1 - HC2)/(ZN1 - ZN2)
         IF ((ABS(AOZ-ZN1) .GT. ABS(AOZ-ZN2)) .AND. I .NE. 1) GO TO 538
         HC3 = HC1 + (AOZ - ZN1)*DELTA
         ZN2 = ZN1
         HC2 = HC1
         HC1 = HC3
         IF (HC1 .LT. 0.0) HC1 = 2.0
         GO TO 540
  538    HC1 = HC2 + (AOZ - ZN2)*DELTA
         IF (HC1 .LT. 0.0) HC1 = 2.0
  540 CONTINUE
C
  542 REDUC = (HCORG - HC1)*100.0/HCORG
      WRITE (IOUT,543) REDUC
C
C  DO SINGLE CALC AT THIS POINT BASED ON USER INPUT OF VOC CHANGE
C
  544 IF (ABS(X(6)).EQ.0.) GO TO 560
      HC1=HCORG*(1.+HCLV*0.01)
      WRITE (IOUT,546) HCLV,PLSP(1)
      CALL SIM(HC1,OXN1,ZN1,10)
C
C  DO OZIPM-2 EKMA OPTION TO GENERATE CHANGE IN OZONE
C
C    (NOT IMPLEMENTED FOR OZIPM-3 AS OF APRIL,1985)
C
  560 IF (X(5).LE.0.) GO TO 570
C
C  RESET VALUES FOR NEXT OPTION
C
  570 CONTINUE
C
C  RESET EMISSIONS IF APPENDIX B WAS USED
C
      IF (HCINSV.LE.HCBK.AND.XNIN.LE.XNBK) GO TO 580
      IF (CFHC.LE.0..AND.CFNOX.LE.0.) GO TO 580
      DO 572 J=1,ISP
      CALL EMISS(IEM,EMO(1,J),ECO(1,J))
  572 CONTINUE
  580 CONTINUE
      NPTO=0
      INFO=0
      OZIN=HCALSV
      OZAL=OZALSV
      HCIN=HCINSV
      HCAL=HCALSV
      XNIN=XNINSV
      XNAL=XNALSV
C
      RETURN
C
C  FORMAT STATEMENTS
C
  300 FORMAT (7F10.5)
  501 FORMAT (1H1,  // 40X,43HEKMA CALCULATIONS ARE PERFORMED TO ESTIMAT
     1E / 1H0,39X,   38HSITE-SPECIFIC VOC CONTROL REQUIREMENTS // 1H0
     1,39X,  36HBASE YEAR OZONE                        ,F10.3,4H PPM / 1H0,
     139X ,36HBASE YEAR NMOC/NOX                     ,F10.3 / 1H0,39X,
     1  36HANTICIPATED CHANGE IN NOX            ,F10.3,8H PERCENT / 1H0,
     139X, 36HFUTURE OZONE TRANSPORTED ALOFT         ,F10.3,4H PPM / 1H0,
     139X, 36HFUTURE NMOC TRANSPORTED ALOFT       ,F10.3,5H PPMC / 1H0,
     139X,  36HFUTURE NOX TRANSPORTED ALOFT        ,F10.3,5H PPM  )
  547 FORMAT (1H0,39X,
     1  36HMEDIAN CONTRIBUTION FACTOR FOR NMOC ,F10.3 / 1H0,39X,
     1  36HMEDIAN CONTRIBUTION FACTOR FOR NOX  ,F10.3 / 1H0,39X,
     1  36HADJUSTED NMOC/NOX                   ,F10.3)
  548 FORMAT (1H0,39X,
     1     36HFUTURE OZONE IN THE SURFACE LAYER    ,F10.3,4H PPM / 1H0,
     139X, 36HFUTURE NMOC IN THE SURFACE LAYER    ,F10.3,5H PPMC / 1H0,
     139X,  36HFUTURE NOX IN THE SURFACE LAYER     ,F10.3,5H PPM  ,
     1 ////  40X,36HTHE FOLLOWING SIMULATIONS WERE DONE./1H0,
     1     15X,4HNMOC,17X,3HNOX,15X,5HRATIO,17X,A4,16X,4HTIME)
C
  524 FORMAT (1H0 // 40X,15HCOULD NOT FIND ,F10.4,10H OZONE IN ,
     1        I3,6H TRYS, // 40X,12HLAST TRY WAS,5X,11HHYDROCARBON,
     2        F10.4,5X,3HNOX,8X,F10.4,5X,5HOZONE,8X,F10.4)
  543 FORMAT (1H0 // 40X,27HVOC CONTROL REQUIREMENT IS ,F5.1,8H PERCENT)
  546 FORMAT (1H1 // 40X,41HTHE FOLLOWING SIMULATION WAS DONE WITH A
     1 / 1H0,39X,F7.2,24H PERCENT CHANGE IN NMOC.    /1H0,
     1     15X,4HNMOC,17X,3HNOX,15X,5HRATIO,17X,A4,16X,4HTIME)
      END
      SUBROUTINE RLINE (NC,F,KS1,JS)
      COMMON /NEED/ HC,XN,NL,NRTO,RTO(20),OZP(20),OZN(8,20),RHO(8,20),MR
     1,OC(4),OS(2),HCS,XNS,LS,HCLL(8),XNLL(8)
      COMMON /CNTRL/ SIG,SIGMA,INFO,NPTO,TSTRT,DTIM,Z1,Z2,DCON,EHC,EXN,F
     1LST,TLST
      COMMON /SPEC/ NS,HCSPEC(15),CARB(15),RCTY(15),XNF(2),IH(15),
     1INOX(2),FINHC(15),FALHC(15),NHC,OZIN,OZAL,HCIN,HCAL,XNIN,XNAL,
     2NOZ,FENX(2),C(91),REACT(91),NI,PLSP(5),KOZ(5)
      COMMON /INOUT/ IN,IOUT,ITAPE,IALN,IALL,INHH
      COMMON /PLTVEC/ HCT(20),OT(20),NT,OHC,HCG,PLTGRD,OXN,XNG,HC1,XN1,T
     1ICZ,DIGZ,CHRZ
      DIMENSION R(20), F(21), YP(12), TMP(12), OE(20), XNE(20)
      INTEGER HCSPEC,REACT,PLSP
      EQUIVALENCE (NR,NRTO), (RTO(1),R(1))
      RLBK(A1,B1,B2,B3)=A1*(B1-B2)/(B3-B2)
      IFG=0
      KFACT=KS1-6+JS
      IF (NC.EQ.1) KFACT=KFACT+2
      KS=MAX0(KFACT/MR,0)
      KS=MIN0(KS,NC)
      KSS=MAX0(KFACT-KS*MR,0)
      KS=KS+1
      IF (KS.GT.NC.AND.KSS.EQ.2) GO TO 5
      IF (INFO.EQ.0) WRITE (IOUT,365) (PLSP(IIC),IIC=1,NOZ)
      IF (INFO.LT.0) WRITE (IOUT,370) (PLSP(IIC),IIC=1,NOZ)
    5 DO 15 J=1,NL
      M=J
      DO 10 L=J,NL
   10 IF (OZP(L).LT.OZP(M)) M=L
      IF (M.EQ.J) GO TO 15
      SV=OZP(J)
      OZP(J)=OZP(M)
      OZP(M)=SV
   15 CONTINUE
      NR=NC
      NSHC=0
      NSXN=0
      KK=0
      MR1=MR-1
      INX=1
      NCR=(NR+1)/2
      TOL=1.0-(0.17/(SQRT(FLOAT(NR))))
      KSN=KS1+1
      IF (KSN.GT.7) GO TO 40
      GO TO (20,25,30,35,40,40,40),KSN
C  DO CORNERS.
   20 CALL SIM (0.,0.,OC(1),INX)
   25 CALL SIM (0.,XN,OC(2),INX)
   30 IF (KS.EQ.1) CALL SIM (HC,XN,OZN(MR,1),INX)
      OC(3)=OZN(MR,1)
   35 CALL SIM (HC,0.,OC(4),INX)
   40 DO 45 LS=1,NL
      IF (OC(1).LT.OZP(LS)) GO TO 50
   45 CONTINUE
      WRITE (IOUT,355) PLSP(1),OC(1)
      STOP
   50 IF (LS.GT.1) WRITE (IOUT,360) PLSP(1),OZP(LS)
      IF (OZP(LS).GT.OC(3)) GO TO 345
      NCYC=0
C     DO DOUBLE ROLLBACK ON EDGES
      OZS=OZP(LS)*0.9
      IF (KSN.GE.7) GO TO 75
      HCG=RLBK (HC,OZS,OC(2),OC(3))
      XNG=RLBK(XN,OZP(LS),OC(4),OC(3))
      IF (HCG.LE.0.) HCG=HC/20.
      IF (XNG.LE.0.) XNG=XN/10.
      IF (XNG.GT.XN) XNG=XN/20.
      IF (NCR.EQ.1) GO TO 90
      GO TO (55,55,55,55,55,65,75),KSN
   55 OS(1)=OZS
      INX=-1
   60 CALL SIM (HCG,XN,OS(1),INX)
      OHC=OS(1)
      IF (INX.NE.(-1)) GO TO 65
      HCG1=RLBK (HCG,OZS,OC(2),OS(1))
      AH=HCG1-HCG
      BH=RLBK(HC-HCG,OZS,OS(1),OC(3))
      HCG=HCG+(ABS(AH)*BH+ABS(BH)*AH)/(ABS(AH)+ABS(BH))
      IF (OS(1).GE.OC(3)) HCG=RLBK(HCG,OZS,OC(2),OC(3))
      HCG=AMIN1(HCG,0.5*HC)
      OS(1)=OZS
      IFG=IFG+1
      IF (IFG.EQ.4) INX=1
      GO TO 60
   65 OS(2)=OZP(LS)
      INX=-1
   70 CALL SIM (HC,XNG,OS(2),INX)
      OXN=OS(2)
      IF (INX.NE.(-1)) GO TO 75
      XNG1=RLBK(XNG,OZP(LS),OC(4),OS(2))
      IF (XNG1.GT.0.5*XN) XNG=XN/3.
      IF (XNG1.LE.0.5*XN) XNG=(RLBK(XN-XNG,OZP(LS),OS(2),OC(3))+XNG+XNG1
     1)/2.
      INX=1
      GO TO 70
   75 IF (KS.GT.NR.AND.KSS.EQ.2) GO TO 245
      IF (KS.GT.NR.AND.KSS.EQ.1) GO TO 80
      IF (KS.GT.NR.AND.KSS.EQ.1) GO TO 80
      AH1=RLBK(HCG,OZS,OC(2),OS(1))-HCG
      BH1=RLBK(HC-HCG,OZS,OS(1),OC(3))
      HCS=HCG+(ABS(AH1)*BH1+ABS(BH1)*AH1)/(ABS(AH1)+ABS(BH1))
      IF (HCS.LE.0.) HCS=HCG
   80 XNS=RLBK(XNG,OZP(LS),OC(4),OS(2))
      IF (XNS.GT.XNG) XNS=RLBK(XN-XNG,OZP(LS),OS(2),OC(3))+XNG
      IF (KS.GT.NR) GO TO 245
      IF (KS.GT.NCR) XSS=XNS
      IF (KS.GT.NCR) OSS=OS(2)
      IF (KS.LT.2) GO TO 90
      IF (KS.EQ.2) GO TO 85
      HTT1=RHO(MR,KS-2)*R(KS-2)/F(KS-2)
      XNN1=RHO(MR,KS-2)/F(KS-2)
   85 HTT=RHO(MR,KS-1)*R(KS-1)/F(KS-1)
      XNN=RHO(MR,KS-1)/F(KS-1)
      IF (KSS.EQ.0) GO TO 90
      HCC=RHO(MR,KS)*R(KS)/F(KS)
      XNX=RHO(MR,KS)/F(KS)
      GO TO 95
   90 XNX=XN
   95 XNX1=0.
      ICNT=KS-1
      DO 240 I=KS,NR
      ICNT=ICNT+1
      IF (I.GT.1) GO TO 100
      HTT=HC
      XNN=XN
      IF (KSS) 175,165,175
  100 IF (I-NCR-1) 105,125,130
  105 OZC=OZN(MR,I-1)*(OZS/OZN(MR,I-1))**(1./FLOAT(NCR+1-I))
      IF (KSS.NE.0) GO TO 120
      HSS=HCS
      OSS=OZS
      IF (OS(1).GT.OZC) HSS=0.
      IF (OS(1).GT.OZC) OSS=OC(2)
      IF (ICNT.GT.2) GO TO 110
      HCC=RLBK(HTT-HSS,OZC,OSS,OZN(MR,I-1))+HSS
      IF (OC(3).GT.OZP(NL)) JJ=NCR-2
      IF (OC(3).LE.OZP(NL)) JJ=NCR-1
      IF (JJ.EQ.0) GO TO 120
      HCC1=HC-(HC-HCS)/FLOAT(JJ)
      HCC=AMAX1(HCC,HCC1)
      GO TO 120
  110 HCC=HTT1-RLBK(HTT1-HTT,OZC,OZN(MR,I-2),OZN(MR,I-1))
      A=RLBK(HTT-HSS,OZC,OSS,OZN(MR,I-1))+HSS
      BX=HTT-HCC
      AX=A-HCS
      IF (OC(3)-OZN(MR,2).GT.0.0) GO TO 115
      AX=0.
      BX=1.
  115 HCC=(HCC*AX+A*BX)/(AX+BX)
      HCC1=HTT-(HTT-HCS)/AMAX0(NCR-I,1)
      HCC=AMAX1(HCC,HCC1)
  120 IF (HCC.GT.TOL*HTT) HCC=TOL*HTT
      HMR4=HC-(FLOAT(I-1)*HC/FLOAT(NCR-1))
      IF (HCC.LT.HMR4) HCC=HMR4
      HTT1=HTT
      HTT=HCC
      XNN=XN
      IF (KSS) 175,155,175
  125 OZC=OC(3)*(OZP(LS)/OC(3))**(1./FLOAT(NCR))
      XNN=XN
      OZL=OC(3)
      OSS=OZP(LS)
      XSS=XNS
      ICNT=0
      IF (KSS) 150,140,150
  130 OZC=OZN(MR,I-1)*(OZP(LS)/OZN(MR,I-1))**(1./FLOAT(NR+2-I))
      OZL=OZN(MR,I-1)
      IF (KS.LE.NCR) GO TO 135
      ICNT=KS-NCR-1
  135 ICNT=ICNT+1
      IF (KSS.NE.0) GO TO 150
      IF (ICNT.LE.2) GO TO 140
      XNX1=XNN1-RLBK(XNN1-XNN,OZC,OZN(MR,I-2),OZN(MR,I-1))
  140 IF (XNN.GT.XSS) GO TO 145
      XSS=0.
      OSS=OC(4)
      XNS=XNS*0.5
  145 XNX=RLBK(XNN-XSS,OZC,OSS,OZL)+XSS
      IF (XNX1.GT.0.0.AND.XNX1.LT.XN) XNX=(XNX+XNX1)/2.0
      IF (OC(3).GT.OZP(NL)) L=1
      IF (OC(3).LE.OZP(NL)) L=2
      IF (NCR.GT.2) XNX=AMAX1(XNX,XNN-(XNN-XNS)/FLOAT(NR+L-I))
      IF (I.LE.NCR+1) GO TO 146
      IF (OC(3).LT.OZN(MR,NCR+1)) XNX=XNN-(XNN-XNS)/FLOAT(NR-I+2)
      IF (OC(3).GT.OZN(MR,NCR+1).AND.I.EQ.NR) XNX=(XNN+2.0*XNS)/3.0
  146 CONTINUE
      IF (I.EQ.NR.AND.XNX.LE.0.) XNX=XNN/2.
      IF (NCR.LE.2) XNX=XN/3.0
      IF (XNX.LT.1.1*XNG.AND.XNX.GT.0.9*XNG) XNX=XNG
  150 IF (XNX.GT.TOL*XNN) XNX=TOL*XNN
      IF (XNX.GT.XN.OR.OZP(LS).LT.OC(4)) XNX=(XN*FLOAT(NR-I)/FLOAT(NCR-1
     1))
      IF (XNX.LE.0.) XNX=1.0E-7
      XNN1=XNN
      XNN=XNX
      HTT=HC
      IF (KSS.NE.0) GO TO 175
  155 IF (OZN(MR,I-1).GT.1.1*OZP(LS)) GO TO 165
      IF (IABS(NCR-I).LE.2) GO TO 165
      GAP=0.
      NCOUNT=I-2
      IF (I.LE.(NR/2+1)) NSTART=1
      IF (I.GT.(NR/2+1)) NSTART=NR/2+1
      DO 160 JJ=NSTART,NCOUNT
      GAP1=OZN(MR,JJ)-OZN(MR,JJ+1)
      IF (GAP1.LT.GAP) GO TO 160
      GAP=GAP1
      HTT=((R(JJ)*RHO(MR,JJ))/F(JJ)+(R(JJ+1)*RHO(MR,JJ+1))/F(JJ+1))/2.0
      XNN=HTT/((R(JJ)+R(JJ+1))/2.)
  160 CONTINUE
  165 R(I)=HTT/XNN
      F(I)=SQRT(R(I)*R(I)+1.)
      RHO(MR,I)=XNN*F(I)
      IF (XNX.EQ.XNG) OZN(MR,I)=OS(2)
      IF (OZP(LS).GE.OC(4)) GO TO 169
      IF (I.NE.NR) GO TO 169
      XNLL(MR)=HC
      GO TO 170
  169 CONTINUE
      IF (I.EQ.1.OR.XNX.EQ.XNG) GO TO 175
      IF (I.EQ.NCR.AND.OZP(LS).GE.OC(2)) INX=-3
      IF (INX.NE.(-3)) GO TO 171
      ITAPE=NR
      CALL EDGMX(RHO(1,I-1),OZN(1,I-1),MR,HMX,OZHX,LX)
      OZN(MR,I)=OZP(LS)*OZN(MR,I-1)/OZHX
      IF (MR.EQ.LX+1) OZN(MR,I)=OZP(LS)/TOL
      OZR=OZN(MR,I)
  171 CONTINUE
      IF (OZP(LS).GE.OC(2)) GO TO 170
      IF (I.NE.NCR) GO TO 170
      R(I)=0.
      F(I)=1.
      RHO(MR,I)=XN
      HTT=0.
      HCLL(MR)=XN
      XNN=XN
  170 CALL SIM (HTT,XNN,OZN(MR,I),INX)
      IF (INX.GT.0) GO TO 175
      HTT2=RLBK(HTT1-HTT,OZR,OZN(MR,I),OZN(MR,I-1))+HTT
      HTT=AMIN1(HTT2,TOL*HTT1)
      IF (HTT.LE.0.) HTT=0.5*HTT1
      R(I)=HTT/XNN
      F(I)=SQRT(R(I)*R(I)+1.)
      RHO(MR,I)=XNN*F(I)
      INX=1
      GO TO 170
  175 IF (KSS.EQ.0) KSS1=2
      IF (KSS.NE.0) KSS1=KSS+1
      IF (KSS.NE.0) KSS1=KSS+1
      IF (MR1) 240,240,180
  180 IF (MR.EQ.2) GO TO 200
      IF (KSS1.GT.MR1) GO TO 195
      DO 190 J=KSS1,MR1
      K=MR-J+1
      OZC=OZN(K+1,I)*(OZP(LS)/OZN(K+1,I))**(1./FLOAT(K))
      IF (K.EQ.MR1) GO TO 185
      RHO1=RHO(K+2,I)-RLBK(RHO(K+2,I)-RHO(K+1,I),OZC,OZN(K+2,I),OZN(K+1,
     1I))
  185 RHO(K,I)=RLBK(RHO(K+1,I),OZC,OC(1),OZN(K+1,I))
      IF (K.EQ.MR1) RHO1=RHO(K,I)
      IF (RHO1.GT.0.) RHO(K,I)=(RHO1+RHO(K,I))/2.0
      FK=AMAX0(K-2,2)
      RHO(K,I)=AMAX1(RHO(K,I),RHO(K+1,I)-(RHO(K+1,I)/FK))
      IF (RHO(K,I).GE.RHO(K+1,I)) RHO(K,I)=RHO(K+1,I)-(RHO(K+1,I)/FK)
      IF (RHO(K,I).LE.0.) RHO(K,I)=RHO(K+1,I)*0.5
C  ****** UPDATED 12/10/80
      RHO(K,I)=AMIN1(RHO(K,I),RHO(MR,I)*FLOAT(K)/FLOAT(MR))
      XNX=RHO(K,I)/F(I)
      HCC=R(I)*XNX
      IF (I.EQ.NCR.AND.OZP(LS).LT.OC(2)) HCLL(K)=XNX
      IF (I.EQ.NR.AND.OZP(LS).LT.OC(4)) XNLL(K)=HCC
      CALL SIM (HCC,XNX,OZN(K,I),INX)
  190 CONTINUE
  195 IF (OZN(2,I).LT.OZP(LS)) RHO(1,I)=0.9*RHO(2,I)
      IF (OZN(2,I).LT.OZP(LS)) GO TO 215
      RHO(1,I)=.9*RHO(2,I)
      NHH=1
      IF (NHH.EQ.1) GO TO 215
  200 OZN(1,I)=OC(1)
      SX=-SIG*3.
      IT=1
      RHO(1,I)=0.
      CALL EDGMX (RHO(1,I),OZN(1,I),MR,HMX,OZHX,LX)
      MM=LX+1
  205 RHO(1,I)=0.
      CALL CURV1 (MM,OZN(1,I),RHO(1,I),SP1,SP2,YP,TMP,SX)
      RHO(1,I)=CURV2(OZP(LS),MR,OZN(1,I),RHO(1,I),YP,SX,IT)
      INX=-2
      IF (IT.GT.0) GO TO 210
      SX=SX*10.
      SX=AMAX1(-50.,SX)
      GO TO 205
  210 IF (RHO(1,I).GT.0.9*RHO(2,I)) RHO(1,I)=0.9*RHO(2,I)
      IF (RHO(1,I).LE.0.) RHO(1,I)=.5*RHO(2,I)
      IF (RHO(1,I).GE.RHO(2,I)) RHO(1,I)=0.5*RHO(2,I)
      IF (RHO(1,I).LE.0.) RHO(1,I)=RHO(2,I)*0.5
  215 XNX=RHO(1,I)/F(I)
      HCC=XNX*R(I)
      OZN(1,I)=OZP(LS)
      IF (OZP(LS).LT.OC(2).AND.I.EQ.NCR) HCLL(1)=XNX
      IF (I.EQ.NR.AND.OZP(LS).LT.OC(4)) XNLL(1)=HCC
      CALL SIM (HCC,XNX,OZN(1,I),INX)
      IF (INX.NE.(-2)) GO TO 235
      AH=RLBK(RHO(1,I),OZP(LS),OC(1),OZN(1,I))-RHO(1,I)
      BH=RLBK((RHO(2,I)-RHO(1,I)),OZP(LS),OZN(1,I),OZN(2,I))
      RHO(1,I)=RHO(1,I)+(ABS(AH)*BH+ABS(BH)*AH)/(ABS(AH)+ABS(BH))
      RHO(1,I)=AMIN1(RHO(1,I),0.9*RHO(2,I))
      IF (RHO(1,I).LE.0.) RHO(1,I)=RHO(2,I)*0.25
      IF (I.EQ.NCR) IFG=IFG+1
      IF (IFG.LT.3.AND.I.EQ.NCR) GO TO 215
  230 INX=1
      GO TO 215
  235 KSS=0
  240 CONTINUE
C  CHECK FOR INCREASING RATIOS
  245 DO 260 I=1,NR
      K=I
      DO 250 J=I,NR
  250 IF (R(J).LT.R(K)) K=J
      IF (K.EQ.I) GO TO 260
      SV=R(I)
      R(I)=R(K)
      R(K)=SV
      SV=F(I)
      F(I)=F(K)
      F(K)=SV
      DO 255 J=1,MR
      SV=OZN(J,I)
      OZN(J,I)=OZN(J,K)
      OZN(J,K)=SV
      SV=RHO(J,I)
      RHO(J,I)=RHO(J,K)
  255 RHO(J,K)=SV
  260 CONTINUE
C  DO SPECIAL CALCULATIONS
      KSS1=KSS+1
      IF (OZP(LS).LT.OC(2)) NCR1=NCR-1
      IF (OZP(LS).GE.OC(2)) NCR1=NCR
      NN=NCR1+1
      SX=-20.*SIG/FLOAT(NN)
      IF (NCR.NE.1) GO TO 265
      OT(1)=OC(2)
      HCT(1)=0.
      OT(2)=OHC
      HCT(2)=HCG
      OT(3)=OC(3)
      HCT(3)=HC
      III=0
      NN=3
      GO TO 295
  265 DO 270 I=1,NCR1
      IF (OZP(LS).LT.OC(2)) L=I+1
      IF (OZP(LS).GE.OC(2)) L=I
      OT(I+2)=OZN(MR,L)
  270 HCT(I+2)=RHO(MR,L)*R(L)/F(L)
      OT(1)=OC(2)
      HCT(1)=0.
      OT(2)=OHC
      HCT(2)=HCG
      NN=NN+1
      IF (KSS1.GT.1) GO TO 300
      IF (HCG.GT.TOL*HCT(3)) HCS=TOL*HCT(3)
      IF (HCS.EQ.TOL*HCT(3)) GO TO 295
      IT=1
  275 CALL CURV1 (NN,OT,HCT,SP1,SP2,YP,TMP,SX)
      DO 280 LK=1,NL
      IF (OZP(LK).GE.OC(2)) GO TO 285
  280 CONTINUE
      LK=NL
  285 OZS=OZP(LK)*0.7
      HCS=CURV2(OZS,NN,OT,HCT,YP,SX,IT)
      IF (IT.GT.0) GO TO 290
      SX=SX*10.
      SX=AMAX1(-50.,SX)
      GO TO 275
  290 IF (HCS.GT.TOL*HCT(3)) HCS=TOL*HCT(3)
  295 IF (NCR.EQ.1) HCS=HC/3.
      IF (HCS.GE.HCT(3).OR.HCS.LE.HCT(1)) HCS=(HCT(1)+HCT(3))/2.
      CALL SIM (HCS,XN,OS(1),INX)
  300 OT(2)=OS(1)
      HCT(2)=HCS
      NT=NN
      IF (KSS1.GT.2) GO TO 340
      SX=-SIG*20./FLOAT(NN)
      XNN=HC/RTO(NR)
      IF (NCR.EQ.1) GO TO 335
      IF (OZN(MR,NR).LT.1.1*OZP(LS)) XNS=XNN*0.5
      IF (OC(4).GT.OZP(LS)) XNS=XNN*0.5
      IF (XNS.EQ.XNN*0.5) GO TO 335
      NCR1=NCR
      IF (OZP(LS).LT.OC(4)) NCR1=NCR-1
      DO 305 I=1,NCR1
      J=NR+1-I
      IF (OZP(LS).LT.OC(4)) J=J+1
      OE(I+1)=OZN(MR,J)
  305 XNE(I+1)=RHO(MR,J)/F(J)
      OE(1)=OC(4)
      XNE(1)=0.
      NN=NCR1+1
  310 IF (OE(NN).LT.OE(NN-1)) NN=NN-1
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      IF (NN.EQ.1) XNS=XNN*0.5
      IF (NN.EQ.1) GO TO 335
      IF (OE(NN).LT.OE(NN-1)) GO TO 310
      IF (XNG.GE.XNE(2)) GO TO 320
      IF (ABS(XNE(2)-XNG).LT..0001) GO TO 325
      NN=NN+1
      NNR=NN-2
      DO 315 I=1,NNR
      II=NN-I+1
      XNE(II)=XNE(II-1)
  315 OE(II)=OE(II-1)
      XNE(2)=XNG
      OE(2)=OXN
      SX=-SIG*20./FLOAT(NN)
  320 IT=1
  325 CALL CURV1 (NN,OE,XNE,SP1,SP2,YP,TMP,SX)
      DO 326 LK=LS,NL
      IF (OZP(LK).GE.OC(4)) GO TO 327
  326 CONTINUE
      LK=NL
  327 XNS=CURV2(OZP(LK),NN,OE,XNE,YP,SX,IT)
      IF (IT.GT.0) GO TO 330
      SX=SX*10.
      SX=AMAX1(-50.,SX)
      GO TO 325
  330 IF (XNS.GT.TOL*XNE(2)) XNS=TOL*XNE(2)
      IF (XNS.GE.XNE(3).OR.XNS.LE.XNE(1)) XNS=(XNE(1)+XNE(3))/2.
  335 IF (NCR.EQ.1) XNS=XN/3.
      CALL SIM (HC,XNS,OS(2),INX)
  340 RETURN
  345 WRITE (IOUT,350) PLSP(1)
      STOP
C
C
C
  350 FORMAT (1H1,11HTHE LOWEST ,A4,24H LINE CANNOT BE PLOTTED./1H0,39HI
     1NCREASE THE MAXIMUM HC AND NOX VALUES.)
  355 FORMAT (1H1,24HNO LINES CAN BE PLOTTED./1H0,35HBACKGROUND ONLY PRO
     1DUCES TOO MUCH  ,A4,1H,,F5.2,5H PPM.)
  360 FORMAT (1H0,45HDUE TO HIGH BACKGROUND CONDITIONS THE LOWEST ,A4,17
     1H PLOTTED WILL BE ,F5.2,5H PPM.)
  365 FORMAT (1H1,//,14X,36HTHE FOLLOWING SIMULATIONS WERE DONE./1H0/1H
     1,6X,4HNMOC,11X,3HNOX,12X,5HRATIO,10X,5(A4,11X))
  370 FORMAT (1H1,//,14X,36HTHE FOLLOWING SIMULATIONS WERE DONE./1H0/1H
     1,6X,4HNMOC,5X,3HNOX,7X,5HRATIO,5(6X,A4,6X,4HTIME))
      END
      SUBROUTINE SIM (HC,XN,ZN,INX)
      COMMON /CALC/ NR,KR(200,12),A(200),S(200),R(200),ITYPE(200),IA(90)
     1,JA(1500),DILUT,TEMP,ERR,START,STOPP,SPECIS(91),TPRNT,TSTEP,ZENI
      COMMON /TITL/ ITTL(36)
      COMMON /HOUR/ OZM(5),NGO,TTM,TM(5)
      COMMON /CNTRL/ SIG,SIGMA,INFO,NPTO,TSRT,DTIM,Z1,Z2,DCON,EHC,EXN,FL
     1ST,TLST
      COMMON /EMIS/ NEM,ISP,ESTRT(5),ESTOP,ESLP,EMSP(5),IEMLS(5),EOSLP(5
     1),EMO(26,5),ECI(5),EM(26),EC(125),ECO(125,5)
      COMMON /HEAT/ SC(200,12),ISC(200,3)
      COMMON /NEED1/ IBLANK,MBLANK,IIHC,IINX,IICO,IINO2,IINO,IIO3,
     1IIH2O,IBZA,JPLUS
      COMMON /FRPLOT/ SAVCON(80,5),SAVTIM(80),NT,INOW
      COMMON /STORE/ AST(60)
      COMMON /INOUT/ INU,IOUT,ITAPE,IALN,IALL,IN1
      COMMON /SPEC/ NS,HCSPEC(15),CARB(15),RCTY(15),XNF(2),IH(15),
     1INOX(2),FINHC(15),FALHC(15),NHC,OZIN,OZAL,HCIN,HCAL,XNIN,XNAL,
     2NOZ,FENX(2),CI(91),REACT(91),NI,PLSP(5),KOZ(5)
      COMMON /SUNLIT/ Z(10),RTCON(10),
     1LAM1,INC,SLA,SLO,TZ,IY,IM,ID,ISTRT,ISTOP,IINC,IEND,SPECIE,MAXZ,ITI
     2ME(24),XZ(24),KK(24),JSTRT,JSTOP,SPEE,MNLM,MXLM,MAXL,MAXJ
      COMMON /PHOTON/ CF(72,20),P(24,20),IPH(20),IP,RFCT(20),PP(10,20)
      COMMON /MIX/ NMIX,AMIX(26),STRM,STOPM,DC(104)
      COMMON /MIXING/ DSTRT,DEND,AMC(5),BMC(5),CMC(5),FD(6),FG(6),
     1AMXX(26),DL,TTMAX,SSRISE,SRMIN,DELH,TDIL,NMXX,HEIGHT,SSET,SRISE
      COMMON /BK1/ FBK(10),FBKAL(5),HCBK,XNBK,OZBK
      DIMENSION RT(200), RX(20), C(91), CO3(5), INST(3,5)
      INTEGER REACT,SPECIS,HCSPEC,PLSP,SPEE,EMSP
      DATA INST/4H(INS,4HTANT,4H)    ,4H(INS,4HTANT,4H)       ,
     14H(INS,4HTANT,4H)      ,4H(INS,4HTANT,4H)      ,4H(INS,4HTANT,4H)     /
      TCI=FLOAT(JSTRT)
      START=0.
      T=START
      TDIL=0.
      TTRS=CLKMIN (TCI)
      TTR1=CLKMIN (SRISE)-10.
      TTR2=CLKMIN (SSET)+10.
      TR1=TTR1-TTRS
      TR2=TTR2-TTRS
      IF (TR2.LE.0.) TR2=2000.
      IF (TR1.GE.0.) GO TO 1
      TR2=1440.+TR1
      TR1=TTR2-TTRS
      IF (TR1.LT.0.) TR1=0.
      IF (TR2.LE.0.) TR2=2000.
    1 IF (IN1.EQ.1) SAV=STOPP
      STOPP=SAV
      FLST=1.0
      TLST=START
      EHC=HC
      EXN=XN
      HCSAV=HC
      XNSAV=XN
      TDC=STOPP/80.
      TD=0.
      DO 2 I=2,80
      TD=TD+TDC
    2 SAVTIM(I)=TD
      SAVTIM(1)=0.
      IF (NPTO.EQ.0) TPRNT=STOPP
      IF (NPTO.NE.0) TTM=5.0
      H=1.E-10
      N=NI
      M=NS-1
      DO 3 J=1,5
    3 ECI(J)=1.
      IF (NEM.LE.2) GO TO 7
      DO 6 I=1,ISP
      DO 4 J=1,M
      IF (EMSP(J).EQ.IIHC.OR.EMSP(J).EQ.IINX) GO TO 4
      IF (SPECIS(J).NE.EMSP(I)) GO TO 4
      ECI(J)=1.
      GO TO 6
    4 CONTINUE
    6 CONTINUE
    7 IF (N.LE.0) GO TO 8
      DO 5 I=1,N
      C(I)=CI(I)
    5 CONTINUE
    8 CALL RATES (C,N)
      IF (IN1.NE.0) CALL SPARS (IA,JA,M)
      DHC=HCIN-HCBK
      DXN=XNIN-XNBK
      IF (DHC.LT.0.) HCIN=HCBK
      IF (DXN.LT.0.) XNIN=XNBK
      DO 10 J=1,NHC
      K=IH(J)
      FBKS=FINHC(J)
      IF (FBK(J).GT.(-0.00001)) FBKS=FBK(J)
      C(K)=(HC*RCTY(J)+HCIN*FINHC(J))/CARB(J)
   10 CONTINUE
      DO 25 K=1,2
      I=INOX(K)
      IF (SPECIS(I).EQ.IINO2) C(I)=XN*XNF(K)+XNIN
      IF (SPECIS(I).NE.IINO2) C(I)=XN*XNF(K)
   25 CONTINUE
      IF (OZIN.EQ.0.) GO TO 40
      DO 26 I=1,NOZ
      IF (PLSP(I).NE.IIO3   ) GO TO 26
      JOZ=KOZ(I)
   C(JOZ)=OZIN
   GO TO 40
26 CONTINUE
30 DO 35 I=1,N
   IF (SPECIS(I).NE.II03  ) GO TO 35
   C(I)=OZIN
   GO TO 40
35 CONTINUE
40 CALL DIFFUN (N,START,C,RT,2)
   HC=HCSAV
   XN=XNSAV
   IF (NPTO.EQ.0) GO TO 50
   WRITE (IOUT,190)
   WRITE (IOUT,200) (ITTL(I),I=1,36)
   IF (INFO.LT.1) WRITE (IOUT,235) (PLSP(I),I=1,NOZ)
   IF (INFO.LT.1) WRITE (IOUT,236) ((INST(I,KI),I=1,3),KI=1,NOZ)
   IF (INFO.LT.1) GO TO 50
   IF (NI.NE.0) WRITE (IOUT,245) (REACT(I),I=1,NI)
   IF (NI.NE.0) WRITE (IOUT,250) (CI(I),I=1,NI)
   WRITE (IOUT,215) ERR,TEMP,HEIGHT
   WRITE (IOUT,220) (R(IR),IR=1,NR)
   IF (IP.EQ.0) GO TO 50
   DO 45 I=1,IP
   K=IPH(I)
45 RX(I)=R(K)
   WRITE (IOUT,225) (IPH(IR),IR=1,IP)
   WRITE (IOUT,230) (RX(IR),IR=1,IP)
50 IN=1
   IF (IN1.EQ.0) IN=4
   IN1=0
   DILUT=DCON
   IF (TSRT.LE.START.AND.DTIM.NE.0.) DILUT=ALOG(Z2/Z1)/DTIM
   ERRSAV=ERR
   TNEXT=1.
   IF (NPTO.EQ.0) GO TO 90
   IF (T-START) 115,115,90
55 IF (AMIX(1).GT.(-1.).AND.T.GE.TDIL) TDIL=TDIL+60.
   ERR=ERRSAV
   TTIM=TR1
   IF (T.GE.TTIM) TTIM=TR2
   IF (T.GE.TR2) TTIM=2000.
   IF (DTIM.EQ.0.) GO TO 85
   IF (T.GE.TSRT) GO TO 70
   DILUT=DCON
   IF (TSRT-TPRNT-20.) 60,60,65
60 TNEXT=AMIN1(TSRT,TTIM)
   IN=2
   GO TO 90
65 TNEXT=AMIN1(TPRNT,TTIM)
   IN=0
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      GO TO 90
   70 IF (AMIX(1).LT.(-1.)) GO TO 71
      TNEXT=AMIN1(TDIL,TPRNT,TTIM)
      IF (T.GE.TSRT+DTIM) GO TO 85
      GO TO 74
   71 IF (T.GE.TSRT+DTIM) GO TO 85
      DILUT=ALOG(Z2/Z1)/DTIM
      FLST=EXP(-DCON*TSRT)
      TLST=TSRT
      TNEXT=TSRT+DTIM
      TNEXT=AMIN1(TNEXT,TTIM)
   74 IF (TNEXT-TPRNT-20.) 75,75,80
   75 IN=2
      GO TO 90
   80 TNEXT=AMIN1(TPRNT,TTIM)
      IN=0
      GO TO 90
   85 TNEXT=AMIN1(TPRNT,TTIM,STOPP)
      FLST=EXP(-DCON*TSRT)*Z1/Z2
      TLST=TSRT+DTIM
      DILUT=DCON
   90 CALL DRIVES (M,T,H,C,TNEXT,ERR,21,IN,IA,JA)
      T=TNEXT
      IF (NPTO.NE.0) GO TO 100
      IF (T.LT.STOPP) GO TO 55
      IF (INX.GT.(-1)) GO TO 100
      IF (INX.EQ.(-1).AND.OZM(1).GT.0.75*ZN) GO TO 100
      IF (INX.NE.(-3)) GO TO 91
      TOL=1.0-(0.17/(SQRT(FLOAT(ITAPE))))
      IF (OZM(1).GE.TOL*ZN.AND.OZM(1).LE.ZN/TOL) GO TO 100
   91 CONTINUE
      IF (INX.NE.(-2)) GO TO 95
      IF (OZM(1).LT.1.1*ZN.AND.OZM(1).GT.0.9*ZN) GO TO 100
   95 ZN=OZM(1)
      RETURN
  100 ZN=OZM(1)
      IF (NPTO.NE.0) GO TO 110
      IF (INX.LT.5) INX=1
      IF (T.LT.STOPP) GO TO 55
      IF (XN.EQ.0.) RR=0.
      IF (XN.NE.0.) RR=HC/XN
      IF (INFO.LT.0) GO TO 105
      IF (TM(1).GT.0.) WRITE (IOUT,165) HC,XN,RR,(OZM(J),J=1,NOZ)
      IF (TM(1).LE.0.) WRITE (IOUT,185) HC,XN,RR,(OZM(J),J=1,NOZ)
      WRITE (IALN,1000) HC,XN,(OZM(J),J=1,NOZ)
      RETURN
  105 CONTINUE
      CTEND=CLOCK(TCI,IFIX(STOPP))
      IF (CTEND.GT.2400.) CTEND=CTEND-2400.
      DO 106 J=1,NOZ
      IF (TM(J).LE.0.) RT(J)=CTEND
      IF (TM(J).GT.0.) RT(J)=CLOCK(TCI,IFIX(TM(J)))
      IF (RT(J).GT.2400.) RT(J)=RT(J)-2400.
  106 CONTINUE
      IF (INX.LT.5)
     1WRITE (IOUT,205) HC,XN,RR,(OZM(IIC),RT(IIC),IIC=1,NOZ)
      IF (TM(1).GT.0..AND.INX.GT.5) WRITE (IOUT,400) HC,XN,RR,OZM(1)
     1,RT(1)
      IF (TM(1).LE.0..AND.INX.GT.5) WRITE (IOUT,450) HC,XN,RR,OZM(1)
      WRITE (IALN,1000) HC,XN,(OZM(J),J=1,NOZ)
      RETURN
  110 IF (IN.NE.0) RETURN
      IF (T.GE.STOPP) TPRNT=STOPP
      IF (T.LT.TPRNT) GO TO 55
  115 HCC=0.
      DO 120 I=1,NHC
      K=IH(I)
  120 HCC=HCC+CARB(I)*C(K)
      CNOX=0.
      DO 145 I=1,2
      K=INOX(I)
      IF (I.EQ.1) FNO2=C(K)
  145 CNOX=CNOX+C(K)
      IF (CNOX.LE.0.0000001) FNO2=0.
      IF (CNOX.GT.0.0000001) FNO2=FNO2/CNOX
      IF (CNOX.LE.0.000001) RNX=0.
      IF (CNOX.GT.0.000001) RNX=HCC/CNOX
      DO 146 I=1,NOZ
      JOZ=KOZ(I)
      CO3(I)=C(JOZ)
  146 CONTINUE
      IF (INFO.GT.0) WRITE (IOUT,190)
      IF (INFO.GT.0) WRITE (IOUT,235) (PLSP(I),I=1,NOZ)
      IF (INFO.GT.0) WRITE (IOUT,236) ((INST(I,KI),I=1,3),KI=1,NOZ)
      IF (T.EQ.START) TIMNW=START
      IF (T.NE.START) TIMNW=TPRNT
      CTIME=CLOCK(TCI,IFIX(TIMNW))
C
C  ****** UPDATED 11/81 FOR 24 HR RUNS
C
      IF (CTIME.GT.2400.) CTIME=CTIME-2400.
      WRITE (IOUT,240) CTIME,HCC,RNX,CNOX,FNO2,(CO3(I),I=1,NOZ)
      IF (INFO.LE.0) GO TO 160
      WRITE (IOUT,180) (SPECIS(I),I=1,M)
      WRITE (IOUT,195) CTIME,(C(I),I=1,10),H,(C(I),I=11,M)
      CALL DIFFUN (N,TIMNW,C,RT,1)
      WRITE (IOUT,170) (RT(I),I=1,M)
      DO 150 I=1,NR
      J=KR(I,1)
      IF (J.EQ.0) RT(I)=0.
      IF (J.EQ.0) GO TO 150
      JT=ITYPE(I)
      XT=1.
      DO 149 L=1,JT
      J=KR(I,L)
      XJ=1.
      IF (J.GT.0) XJ=C(J)**ISC(I,L)
      IF (ISC(I,J).EQ.(-1)) XJ=C(J)**SC(I,L)
      XT=XT*XJ
  149 CONTINUE
      RT(I)=XT*R(I)
  150 CONTINUE
      WRITE (IOUT,175) (RT(I),I=1,NR)
      IF (IP.EQ.0) GO TO 160
      DO 155 I=1,IP
      K=IPH(I)
  155 RX(I)=R(K)
      WRITE (IOUT,230) (RX(I),I=1,IP)
      WRITE (IOUT,255) HEIGHT,TEMP,ZENI
  160 IF (TNEXT.EQ.1.) ERR=AMIN1(1.,100.*ERR)
      IF (TIMNW.EQ.START) GO TO 90
      IF (NPTO.NE.0) IN1=1
      IF (T.GE.STOPP) RETURN
      TPRNT=TPRNT+TSTEP
      GO TO 55
C
C  FORMAT STATEMENTS
C
  165 FORMAT (1H0,F11.5,4X,F11.5,5X,F11.5,5X,5(1PE12.5,3X))
  170 FORMAT (/10H NET RATES,1X,1P10E12.3/(11X,1P10E12.3))
  175 FORMAT (//1X,22HTHE REACTION RATES ARE/(1H ,1P10E13.2))
  180 FORMAT (//3X,5HTIME ,4X,10(4X,A4,4X)/1X,8HINTERVAL,3X,10(4X,A4,
     14X)/(12X,10(4X,A4,4X)))
  185 FORMAT (1H0,F11.5,4X,F11.5,5X,F11.5,5X,5(1PE12.5,3X),8H NOT MAX)
  190 FORMAT (1H1/)
  195 FORMAT (/1PE11.3,10E12.3/E11.3,10E12.3/(11X,10E12.3))
  200 FORMAT (46X,36A2)
  205 FORMAT (1H0,F11.5,F9.5,F11.5,2X,4(1PE10.4,3X,0PF5.0,2X),1PE10.4,
     13X,0PF5.0)
  215 FORMAT (24H0THE ERROR TOLERANCE IS ,1PE10.3/
     125H0THE TEMPERATURE USED IS ,E10.3/
     221H0THE MIXING HEIGHT IS ,E10.2)
  220 FORMAT (29H0THE RATE CONSTANTS USED WERE//(1H0,1P10E13.3))
  225 FORMAT (29H0THE PHOTOLYSIS REACTIONS ARE/(1H0,9I13))
  230 FORMAT (34H0THE PHOTOLYTIC RATE CONSTANTS ARE/(5X,1P9E13.3))
  235 FORMAT (1H0,10X,4HTIME,6X,4HNMOC,7X,5HNMOC/,8X,3HNOX, 9X,3HNO2,9X,
     1A4,4(8X,A4))
  236 FORMAT(10X,6H(LDT ),4X,5HTOTAL,8X,3HNOX,8X,5HTOTAL,6X,8HFRACTION,
     23X,5(3A4))
  240 FORMAT (1H0,8X,F6.0,1X,F10.5,2X,F10.5,2X,F10.5,2X,F10.5,2X,F10.5,
     15(2X,F10.5))                                                   X   301
 245 FORMAT (1H0,22HINITIAL CONCENTRATIONS//(12X,10(4X,A4,4X)))      X   302
 250 FORMAT (/(10X,1P10E12.3))                                       X   303
 255 FORMAT (//30H0THE CURRENT MIXING HEIGHT IS  ,F10.2/            X   304
    130H0THE CURRENT TEMPERATURE IS    ,F10.2/                       X   305
    230H0THE CURRENT ZENITH ANGLE IS  ,F10.2)                        X   306
 400 FORMAT (1H0,4F20.5,F21.0)                                       X   307
 450 FORMAT (1H0,4F20.5,14X,7HNOT MAX)                               X   308
1000 FORMAT (1X,7E13.4)                                              X   309
     END                                                             X   310-
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      SUBROUTINE DRIVES (N,T0,H0,Y0,TOUT,EPS,MF,INDEX,IA,JA)
      COMMON /CNTRL/ SIG,SIGMA,INFO,NPTO,TSRT,DTIM,Z1,Z2,DCON,EHC,EXN,FL
     1ST,TLST
      COMMON /SPEC/ NS,HCSPEC(15),CARB(15),RCTY(15),XNF(2),IH(15),
     1INOX(2),FINHC(15),FALHC(15),NHC,OZIN,OZAL,HCIN,HCAL,XNIN,XNAL,
     2NOZ,FENX(2),C(91),REACT(91),NI,PLSP(5),KOZ(5)
      DIMENSION IA(1), JA(1), Y0(N)
      DIMENSION Y(91,6)
      COMMON /GEAR1/ T,H,HMIN,HMAX,EPSC,UROUND,NC,MFC,KFLAG,JSTART
      COMMON /GEAR2/ YMAX(100)/GEAR3/ERROR(100)/GEAR4/W1(90,3)
      COMMON /GEAR5/ IW1(91,9)/GEAR6/W2(2000)/GEAR7/IW2(2000)
      COMMON /GEAR8/ EPSJ,IPT12,IPT13,IPT14,IPTR2,IPTR3,NGRP
      COMMON /GEAR9/ HUSED,NQUSED,NSTEP,NFE,NJE,NZA,NPL,NPU,NZL,NZU,NZRO
      COMMON /INOUT/ INP,LOUT,ITAPE,IALN,IALL,INHH
      INTEGER HCSPEC,REACT,PLSP
      DATA NMX/90/,LENW2/2000/,LENIW2/2000/
      NGP=0
      IF (INDEX.EQ.4) GO TO 15
      IF (INDEX.EQ.0) GO TO 30
      IF (INDEX.EQ.2) GO TO 35
      IF (INDEX.EQ.(-1)) GO TO 40
      IF (INDEX.EQ.3) GO TO 45
      IF (INDEX.NE.1) GO TO 125
      IF (EPS.LE.0.) GO TO 110
      IF (N.LE.0) GO TO 115
      IF ((T0-TOUT)*H0.GE.0.) GO TO 120
      MITER=MF-10*(MF/10)
      IF ((MITER.NE.1).AND.(MITER.NE.2)) GO TO 15
      NP1=N+1
      NZA=IA(NP1)-1
      MAX=LENIW2/2
      IPT12=MAX+1
      CALL SORDER (N,IA,JA,IW1,IW1(1,5),MAX,IW2,IW2(IPT12),IER)
      IPT12=NZA+1
      IF (IPT12+NZA-1.GT.LENIW2) GO TO 135
      DO 5 I=1,NP1
    5 IW1(I,2)=IA(I)
      DO 10 I=1,NZA
   10 IW2(I)=JA(I)
      CALL NSCORD (N,IW1(1,2),IW2,IW1(1,3),IW2(IPT12),IW1,IW1(1,5),IW1(1
     1,8))
      MAXPL=(LENIW2-NZA)/2
      IPT13=IPT12+MAXPL
      MAXPU=LENIW2-IPT13+1
      CALL NSSFAC (N,IW1(1,2),IW2,MAXPL,IW1(1,3),IW2(IPT12),IW1(1,4),MAX
     1PU,IW1(1,5),IW2(IPT13),IW1(1,6),Y(1,6),IW1(1,9),Y,Y(1,2),Y(1,3),IW
     21(1,7),IW1(1,8),Y(1,4),Y(1,5),IER)
      NPL=IW1(N,4)
      NPU=IW1(N,6)
      NZL=IW1(N+1,3)
      NZU=IW1(N+1,5)
      IPTR2=NZA+1
      IPTR3=IPTR2+MAX0(NZA,NZL)
      IF (IPTR3+MAX0(NZA,NZU)-1.GT.LENW2) GO TO 135
   15 DO 20 I=1,N
      YMAX(I)=ABS(Y0(I))
      IF (YMAX(I).EQ.0.) YMAX(I)=1.E-10
   20 Y(I,1)=Y0(I)
      NC=N
      T=T0
      H=H0
      NZRO=0
      TST=EPS*1.E-10
      DO 25 I=1,N
   25 IF (Y(I,1).GT.TST) NZRO=NZRO+1
      NZRO=MAX0(NZRO,1)
      NOLD=NZRO
      HMIN=ABS(H0)
      HMAX=ABS(T0-TOUT)*10.
      HMAX=AMIN1(HMAX,20.)
      EPSC=EPS
      MFC=MF
      JSTART=0
      N0=N
      CALL OZMX (Y,TL,TOUT,N0)
      NMX1=NMX+1
      EPSJ=SQRT(UROUND)
      NHCUT=0
      GO TO 50
   30 HMAX=ABS(TOUT-TOUTP)*10.
      HMAX=AMIN1(HMAX,20.)
      GO TO 70
   35 HMAX=ABS(TOUT-TOUTP)*10.
      HMAX=AMIN1(HMAX,20.)
      IF ((T-TOUT)*H.GE.0.) GO TO 140
      GO TO 75
   40 IF ((T-TOUT)*H.GE.0.) GO TO 130
      JSTART=-1
      NC=N
      EPSC=EPS
      TST=EPS*1.E-10
      MFC=MF
   45 CONTINUE
   50 CONTINUE
      CALL STIFFS (Y,N0,IA,JA,W1,NMX,IW1,NMX1)
      JOZ=KOZ(1)
      KGO=1-KFLAG
      GO TO (55,85,100,90),KGO
   55 CONTINUE
      IF (T.GE.TL) CALL OZMX (Y,TL,TOUT,N0)
      D=0.
      NZRO=0
      DO 65 I=1,NC
      IF (Y(I,1).GE.0.) GO TO 60
      NGP=NGP+1
      DO 56 J=1,6
      K=(J-1)*N+I
   56 Y(K,1)=0.
   60 CONTINUE
      IF (Y(I,1).GT.TST) NZRO=NZRO+1
      AYI=ABS(Y(I,1))
      YMAX(I)=AMAX1(1.E-10,AYI)
   65 D=D+(AYI/YMAX(I))**2
      NZRO=MAX0(NZRO,1)
      DO 66 II=1,NC
   66 Y0(II)=Y(II,1)
      CALL SAVIT (T,Y0,N)
      IF (NZRO.NE.NOLD) JSTART=-1
      IF (NZRO.NE.NOLD) NOLD=NZRO
      D=D*(UROUND/EPS)**2
      IF (D.GT.FLOAT(N)) GO TO 105
      IF (INDEX.EQ.3) GO TO 140
      IF (INDEX.EQ.2) GO TO 75
   70 IF ((T-TOUT)*H.LT.0.) GO TO 45
      CALL INTERP (TOUT,Y,N0,Y0)
      GO TO 150
   75 IF (T.GE.TOUT) GO TO 80
      IF (((T+H)-TOUT).LE.0.) GO TO 45
      H=(TOUT-T)*(1.+4.*UROUND)
      JSTART=-1
      GO TO 45
   80 JSTART=-1
      H=AMIN1(H,1.)
      GO TO 140
   85 CONTINUE
   90 IF (NHCUT.EQ.10) GO TO 95
      NHCUT=NHCUT+1
      HMIN=.1*HMIN
      H=.1*H
      JSTART=-1
      GO TO 45
   95 WRITE (LOUT,155)
      IF (KGO.EQ.4) WRITE (LOUT,170) T
      STOP
  100 WRITE (LOUT,160) T,H
      STOP
  105 WRITE (LOUT,165) T
      KFLAG=-2
      STOP
  110 WRITE (LOUT,175)
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      STOP
  115 WRITE (LOUT,180)
      STOP
  120 WRITE (LOUT,185)
      STOP
  125 WRITE (LOUT,190) INDEX
      STOP
  130 WRITE (LOUT,195) T,TOUT,H
      STOP
  135 WRITE (LOUT,200)
      STOP
  140 TOUT=T
      DO 145 I=1,N
  145 YO(I)=Y(I,1)
      CALL SAVIT (TOUT,YO,N)
  150 INDEX=KFLAG
      TOUTP=TOUT
      HO=HUSED
      IF (KFLAG.NE.0) HO=H
      RETURN
C
C  FORMAT STATEMENTS
C
  155 FORMAT (//44H PROBLEM APPEARS UNSOLVABLE WITH GIVEN INPUT//)
  160 FORMAT (//35H KFLAG = -2 FROM INTEGRATOR AT T = ,E16.8,5H  H =,E16
     1.8/52H  THE REQUESTED ERROR IS SMALLER THAN CAN BE HANDLED//)
  165 FORMAT (//37H INTEGRATION HALTED BY DRIVER AT T = ,E16.8/56H  EPS
     1TOO SMALL TO BE ATTAINED FOR THE MACHINE PRECISION/)
  170 FORMAT (//35H KFLAG = -3 FROM INTEGRATOR AT T = ,E16.8/45H  CORREC
     1TOR CONVERGENCE COULD NOT BE ACHIEVED/)
  175 FORMAT (//28H ILLEGAL INPUT.. EPS .LE. 0.//)
  180 FORMAT (//25H ILLEGAL INPUT.. N .LE. 0//)
  185 FORMAT (//36H ILLEGAL INPUT.. (TO-TOUT)*H .GE. 0.//)
  190 FORMAT (//24H ILLEGAL INPUT.. INDEX =,I5//)
  195 FORMAT (//44H INDEX = -1 ON INPUT WITH (T-TOUT)*H .GE. 0./4H T =,E
     116.8,9H   TOUT =,E16.8,6H   H =,E16.8)
  200 FORMAT (//42H INSUFFICIENT WORKING STORAGE IN IW2 OR W2//)
      END
      SUBROUTINE STIFFS (Y,NO,IA,JA,W1,NMX,IW1,NMX1)
      COMMON /GEAR1/ T,H,HMIN,HMAX,EPS,UROUND,N,MF,KFLAG,JSTART
      COMMON /GEAR2/ YMAX(100)/GEAR3/ERROR(100)
      COMMON /GEAR6/ W2(2000)/GEAR7/IW2(2000)
      COMMON /GEAR8/ EPSJ,IPTI2,IPTI3,IPTI4,IPTR2,IPTR3,NGRP
      COMMON /GEAR9/ HUSED,NQUSED,NSTEP,NFE,NJE,IDUMMY(5),NZRO
      COMMON /HEAT/ SC(200,12),ISC(200,3)
      COMMON /CALC/ NR,KR(200,12),A(200),S(200),R(200),ITYPE(200),IB(90)
     1,JB(1500),DILUT,TEMP,ERR,START,STOPP,SPECIS(91),TPRNT,TSTEP,ZENI
      COMMON /DEPOS/ IDEPO,RDEPO(26,10),LOCDEP(10),ISPDP(10),RDCOEF(125,
     110),IDPTIM,DPEND,RDEP1(26,10),DNOWS
      DIMENSION Y(NO,1), IA(1), JA(1), W1(NMX,1), IW1(NMX1,1)
      DIMENSION EL(13), TQ(4), RT(3)
      INTEGER SPECIS
      DATA EL(2)/1./,OLDLO/1./
      KFLAG=0
      TOLD=T
      IF (JSTART.GT.0) GO TO 50
      IF (JSTART.NE.0) GO TO 10
      CALL DIFFUN (N,T,Y,W1,1)
      DO 5 I=1,N
    5 Y(I,2)=H*W1(I,1)
      METH=MF/10
      MITER=MF-10*METH
      NQ=1
      L=2
      IDOUB=3
      RMAX=1.E4
      RC=0.
      CRATE=1.
      HOLD=H
      MFOLD=MF
      NSTEP=0
      NSTEPJ=0
      NFE=1
      NJE=0
      IRET=3
      GO TO 15
   10 IF (MF.EQ.MFOLD) GO TO 25
      MEO=METH
      MIO=MITER
      METH=MF/10
      MITER=MF-10*METH
      MFOLD=MF
      IF (MITER.NE.MIO) IWEVAL=MITER
      IF (METH.EQ.MEO) GO TO 25
      IDOUB=L+1
      IRET=1
   15 CALL COSET (METH,NQ,EL,TQ,MAXDER)
      LMAX=MAXDER+1
      RC=RC*EL(1)/OLDLO
      OLDLO=EL(1)
   20 FN=FLOAT(NZRO)
      EDN=FN*(TQ(1)*EPS)**2
      E=FN*(TQ(2)*EPS)**2
      EUP=FN*(TQ(3)*EPS)**2
      BND=FN*(TQ(4)*EPS)**2
      EPSOLD=EPS
      NOLD=NZRO
      GO TO (30,35,50),IRET
   25 IF (EPS.EQ.EPSOLD.AND.NZRO.EQ.NOLD) GO TO 30
      IRET=1
      GO TO 20
   30 IF (H.EQ.HOLD) GO TO 50
      RH=H/HOLD
      H=HOLD
      IREDO=3
      GO TO 40
   35 RH=AMAX1(RH,HMIN/ABS(H))
   40 RH=AMIN1(RH,HMAX/ABS(H),RMAX)
      R1=1.
      DO 45 J=2,L
      R1=R1*RH
      DO 45 I=1,N
   45 Y(I,J)=Y(I,J)*R1
      H=H*RH
      RC=RC*RH
      IDOUB=L+1
      IF (IREDO.EQ.0) GO TO 275
   50 IF (ABS(RC-1.).GT.0.3) IWEVAL=MITER
      IF (NSTEP.GE.NSTEPJ+20) IWEVAL=MITER
      T=T+H
      DO 55 J1=1,NQ
      DO 55 J2=J1,NQ
      J=(NQ+J1)-J2
      DO 55 I=1,N
   55 Y(I,J)=Y(I,J)+Y(I,J+1)
   60 DO 65 I=1,N
      IF (Y(I,1).LT.1.E-5) GO TO 65
      IF (Y(I,1).LT.(-2.*Y(I,2))) GO TO 145
   65 ERROR(I)=0.
      M=0
      CALL DIFFUN (N,T,Y,W1(1,2),1)
      NFE=NFE+1
      IF (IWEVAL.LE.0) GO TO 125
      IWEVAL=0
      RC=1.
      NJE=NJE+1
      NSTEPJ=NSTEP
      CON=-H*EL(1)
      ISV=M
      LSV=L
      NZ=IA(N+1)-1
      DO 70 I=1,NZ
   70 W2(I)=0.
      DO 110 IR=1,NR
      IF (KR(IR,1).EQ.0.OR.KR(IR,1).EQ.99) GO TO 110
      MT=ITYPE(IR)
      DO 75 I=1,MT
      JX=I+1-I/3*3
      KX=I+2-I/2*3
      J=KR(IR,JX)
      K=KR(IR,KX)
      IF (J.EQ.0) XX=1.
      IF (J.GT.0) XX=Y(J,1)
      IF (K.EQ.0) XK=1.
      IF (K.GT.0) XK=Y(K,1)
   75 RT(I)=R(IR)*XX*XK
      DO 105 K=1,MT
      I=KR(IR,K)
      DO 85 L=1,MT
      J=KR(IR,L)
      M=IA(J)-1
   80 M=M+1
      IF (I-JA(M)) 80,85,80
   85 W2(M)=W2(M)-RT(L)
      DO 100 L=4,12
      J=KR(IR,L)
      M=IA(I)-1
      IF (J) 100,105,90
   90 M=M+1
      IF (J-JA(M)) 90,95,90
   95 W2(M)=W2(M)+RT(K)*SC(IR,L)
  100 CONTINUE
  105 CONTINUE
  110 CONTINUE
      DO 120 J=1,N
      KMIN=IA(J)
      KMAX=IA(J+1)-1
      DO 115 K=KMIN,KMAX
      W2(K)=W2(K)*CON
      IF (JA(K).EQ.J) W2(K)=W2(K)+1.-CON*DILUT-CON*DNOWS
  115 CONTINUE
  120 CONTINUE
      CALL NSCORA (N,IA,JA,W2,IW1(1,2),W2(IPTR3),W2(IPTR2),IW1,IW1(1,7),
     1IW1(1,8))
      CALL NSNFAC (N,IW1(1,2),IW2,W2,IW1(1,3),IW2(IPTI2),IW1(1,4),W2(IPT
     1R2),W1(1,3),IW1(1,5),IW2(IPTI3),IW1(1,6),W2(IPTR3),W1,IW1(1,7),IW1
     2(1,8),IER)
      M=ISV
      L=LSV
      IF (IER.NE.0) GO TO 145
  125 DO 130 I=1,N
  130 W1(I,1)=H*W1(I,2)-(Y(I,2)+ERROR(I))
      CALL NSBSLV (N,IW1,IW1,IW1(1,3),IW2(IPTI2),IW1(1,4),W2(IPTR2),W1(1
     1,3),IW1(1,5),IW2(IPTI3),IW1(1,6),W2(IPTR3),W1(1,2),W1,W2)
      D=0.
      DO 135 I=1,N
      ERROR(I)=ERROR(I)+W1(I,2)
      D=D+(W1(I,2)/YMAX(I))**2
  135 W1(I,1)=Y(I,1)+EL(1)*ERROR(I)
      IF (M.NE.0) CRATE=AMAX1(.9*CRATE,D/D1)
      IF ((D*AMIN1(1.,2.*CRATE)).LE.BND) GO TO 160
      D1=D
      M=M+1
      IF (M.EQ.3) GO TO 140
      CALL DIFFUN (N,T,W1,W1(1,2),1)
      GO TO 125
  140 NFE=NFE+2
      IF (IWEVAL.EQ.(-1)) GO TO 155
  145 T=TOLD
      RMAX=2.
      DO 150 J1=1,NQ
      DO 150 J2=J1,NQ
      J=(NQ+J1)-J2
      DO 150 I=1,N
  150 Y(I,J)=Y(I,J)-Y(I,J+1)
      IF (ABS(H).LE.HMIN*1.00001) GO TO 270
      RH=.25
      IREDO=1
      GO TO 35
  155 IWEVAL=MITER
      GO TO 60
  160 IF (MITER.NE.0) IWEVAL=-1
      NFE=NFE+M
      D=0.
      DO 165 I=1,N
  165 D=D+(ERROR(I)/YMAX(I))**2
      IF (D.GT.E) GO TO 180
      KFLAG=0
      IREDO=0
      NSTEP=NSTEP+1
      HUSED=H
      NQUSED=NQ
      DO 170 J=1,L
      DO 170 I=1,N
  170 Y(I,J)=Y(I,J)+EL(J)*ERROR(I)
      IF (IDOUB.EQ.1) GO TO 190
      IDOUB=IDOUB-1
      IF (IDOUB.GT.1) GO TO 280
      IF (L.EQ.LMAX) GO TO 280
      DO 175 I=1,N
  175 Y(I,LMAX)=ERROR(I)
      GO TO 280
  180 KFLAG=KFLAG-1
      T=TOLD
      DO 185 J1=1,NQ
      DO 185 J2=J1,NQ
      J=(NQ+J1)-J2
      DO 185 I=1,N
  185 Y(I,J)=Y(I,J)-Y(I,J+1)
      RMAX=2.
      IF (ABS(H).LE.HMIN*1.00001) GO TO 260
      IF (KFLAG.LE.(-3)) GO TO 250
      IREDO=2
      PR3=1.E+20
      GO TO 200
  190 PR3=1.E+20
      IF (L.EQ.LMAX) GO TO 200
      D1=0.
      DO 195 I=1,N
  195 D1=D1+((ERROR(I)-Y(I,LMAX))/YMAX(I))**2
      ENQ3=.5/FLOAT(L+1)
      PR3 = ((D1/EUP)**ENQ3) * 1.4 + 1.4E-6
  200 ENQ2=.5/FLOAT(L)
      PR2=((D/E)**ENQ2)*1.2+1.2E-6
      PR1=1.E+20
      IF (NQ.EQ.1) GO TO 210
      D=0.
      DO 205 I=1,N
  205 D=D+(Y(I,L)/YMAX(I))**2
      ENQ1=.5/FLOAT(NQ)
      PR1=((D/EDN)**ENQ1)*1.3+1.3E-6
  210 IF (PR2.LE.PR3) GO TO 215
      IF (PR3.LT.PR1) GO TO 225
      GO TO 220
  215 IF (PR2.GT.PR1) GO TO 220
      NEWQ=NQ
      RH=1./PR2
      GO TO 240
  220 NEWQ=NQ-1
      RH=1./PR1
      GO TO 240
  225 NEWQ=L
      RH=1./PR3
      IF (RH.LT.1.1) GO TO 235
      DO 230 I=1,N
  230 Y(I,NEWQ+1)=ERROR(I)*EL(L)/FLOAT(L)
      GO TO 245
  235 IDOUB=10
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      GO TO 280
  240 IF ((KFLAG.EQ.0).AND.(RH.LT.1.1)) GO TO 235
      IF (NEWQ.EQ.NQ) GO TO 35
  245 NQ=NEWQ
      L=NQ+1
      IRET=2
      GO TO 15
  250 IF (KFLAG.EQ.(-9)) GO TO 265
      RH=10.**KFLAG
      RH=AMAX1(HMIN/ABS(H),RH)
      H=H*RH
      CALL DIFFUN (N,T,Y,W1,1)
      NFE=NFE+1
      DO 255 I=1,N
  255 Y(I,2)=H*W1(I,1)
      IWEVAL=MITER
      IDOUB=10
      IF (NQ.EQ.1) GO TO 50
      NQ=1
      L=2
      IRET=3
      GO TO 15
  260 KFLAG=-1
      GO TO 280
  265 KFLAG=-2
      GO TO 280
  270 KFLAG=-3
      GO TO 280
  275 RMAX=100.
  280 HOLD=H
      JSTART=NQ
      RETURN
      END
      SUBROUTINE DIFFUN (L,T,X,XT,IENTRY)
      COMMON /CALC/ NR,KR(200,12),A(200),S(200),R(200),ITYPE(200),IA(90)
     1,JA(1500),DILUT,TEMP,ERR,START,STOPP,SPECIS(91),TPRNT,TSTEP,ZENI
      COMMON /CNTRL/ SIG,SIGMA,INFO,NPTO,TSRT,DTIM,Z1,Z2,DCON,EHC,EXN,FL
     1ST,TLST
      COMMON /SPEC/ NS,HCSPEC(15),CARB(15),RCTY(15),XNF(2),IH(15),
     1INOX(2),FINHC(15),FALHC(15),NHC,OZIN,OZAL,HCIN,HCAL,XNIN,XNAL,
     2NOZ,FENX(2),C(91),REACT(91),NI,PLSP(5),KOZ(5)
      COMMON /HEAT/ SC(200,12),ISC(200,3)
      COMMON /NEED1/ IBLANK,MBLANK,IIHC,IINX,IICO,IINO2,IINO,II03,
     1IIH2O,IBZA,JPLUS
      COMMON /STORE/ AST(60)
      COMMON /TEMPER/ TEMEND,NTEMP,QM(30)
      COMMON /SUNLIT/ ZZ1(10),RTCON(10),
     1LAM1,INC,SLA,SLO,TZ,IY,IM,ID,ISTRT,ISTOP,IINC,IEND,SPECIE,MAXZ,ITI
     2ME(24),XZ(24),KK1(24),JSRT,JSTOP,PSPEC,MNLM,MXLM,MAXL,MAXJ
      COMMON /PHOTON/ CF(72,20),P(24,20),IPH(20),IP,RFCT(20),PP(10,20)
      COMMON /EMIS/ NEM,ISP,ESTRT(5),ESTOP,ESLP,EMSP(5),IEMLS(5),EOSLP(5
     1),EMO(26,5),ECI(5),EM(26),EC(125),ES(125,5)
      COMMON /MIX/ NMIX,AMIX(26),STRM,STOPM,DC(104)
      COMMON /MIXING/ DSTRT,DEND,AMC(5),BMC(5),CMC(5),FD(6),FG(6),
     1AMXX(26),DL,TTMAX,SRISE,SRMIN,DELH,TDIL,NMXX,HT,SSET,SSRISE
      COMMON /ALOFT/ IALFT,CALFT(10),LOCALF(10),ISPAL(10)
      COMMON /DEPOS/ IDEPO,RDEPO(26,10),LOCDEP(10),ISPDP(10),RDCOEF(125,
     110),IDPTIM,DPEND,RDEP1(26,10),DNOWS
      DIMENSION XT(L), X(L), ENOWS(5)
      INTEGER SPECIS,EMSP,PSPEC PLSP,HCSPEC
      COMMON /BK1/ FBK(10),FBKAL(5),HCBK,XNBK,OZBK
C
C     EMULATE MULTIPLE ENTRY WITH COMPUTED GO TO
      GO TO (1000,2000),IENTRY
C
C     MAIN ENTRY POINT
 1000 CONTINUE
      N=L
      DILU=DILUT
      IF(T.LT.TSRT.OR.T.GT.TSRT+DTIM) DILU=0.
      IF(T.LT.TSRT.OR.T.GT.TSRT+DTIM) GO TO 5
      IF (AMIX(1).GT.(-1.)) GO TO 66
      TT=CLOCK(TCI,IFIX(T))
      TT=CLKMIN(TT)
      TT=TT-SRISE
      FDT=TT/DL
      IF(FDT.LT.0.0) FDT=0.0
      K=0
    1 K=K+1
      IF(FDT.GE.FD(K).AND.FDT.LT.FD(K+1)) GO TO 2
      IF(K.LT.5) GO TO 1
      IF(FDT.LT.FD(2)) GO TO 6
      FGG=1.0
      FGSLP=0.0
      GO TO 6
    2 CONTINUE
      XFD=FDT-FD(K)
      FGG=((AMC(K)*XFD+BMC(K))*XFD+CMC(K))*XFD+FG(K)
      FGSLP=(3.*AMC(K)*XFD+2.*BMC(K))*XFD+CMC(K)
    6 HT=SRMIN+FGG*DELH
      DILU=(FGSLP*DELH)/(HT*DL)
      GO TO 5
   66 IF (AMIX(1).LT.0.) GO TO 5
      IF (T.GE.STOPM) DILU=0.
      IF (T.GE.STOPM) GO TO 5
      I=IFIX(T/60.+1.9999995)
      IF (T.LE.TOLD.AND.I.LT.IOLD) I=IOLD
      IOLD=I
      IF (I.LE.1) I=2
      Z=T-FLOAT(I-2)*60.
      HT=((Z*DC(3*I-3)+DC(3*I-4))*Z+DC(3*I-5))*Z+AMIX(I-1)
      DILU=((Z*3.*DC(3*I-3)+2.*DC(3*I-4))*Z+DC(3*I-5))/HT
    5 DILUT=AMAX1(DILU,0.)
      TNOW=TEMP
      ZNOW=ZENI
      DO 10 I=1,N
      XT(I)=-DILUT*X(I)
      IF (SPECIS(I) .EQ. IIH20 ) XT(I)=XT(I)+DILUT*X(I)
   10 IF (SPECIS(I).EQ.II03   ) XT(I)=DILUT*(OZAL-X(I))
      IF (T.LT.TSRT.OR.T.GT.TSRT+DTIM) GO TO 30
      DO 15 K=1,2
      J=INOX(K)
      IF (SPECIS(J).NE.IINO2 ) GO TO 15
      XT(J)=DILUT*(XNAL-X(J))
      GO TO 20
   15 CONTINUE
   20 DO 25 K=1,NHC
      J=IH(K)
      FBKS=FALHC(K)
      IF (FBK(K).GT.(-0.00001)) FBKS=FBK(K)
      XT(J)=DILUT*(FALHC(K)*HCAL/CARB(K)-X(J))
   25 CONTINUE
C
C  ENTRAIN OTHER SPECIES
C
      IF (IALFT.LE.0) GO TO 30
      DO 26 K=1,IALFT
      J=LOCALF(K)
      XT(J)=DILUT*(CALFT(K)-X(J))
   26 CONTINUE
C
C  INPUT EMISSIONS
C
```

```
   30 IF (T.GE.ESTOP) GO TO 65
      FNOW=Z1/HT
      IF (AMIX(1).GE.0.) FNOW=AMIX(1)/HT
   35 I=IFIX(T/60.)
      ENOW=0.
      ZZ=(T-FLOAT(I*60))/60.
      I=(I+1)*5
      IF (NEM.GT.0) ENOW=((((ZZ*EC(I)+EC(I-1))*ZZ+EC(I-2))*ZZ+EC(I-3
     1))*ZZ+EC(I-4))*FNOW/60.
      DO 31 J=1,5
   31 ENOWS(J)=ENOW
      IF (NEM.GT.(-1)) GO TO 43
      DO 32 J=1,ISP
   32 ENOWS(J)=((((ZZ*ES(I,J)+ES(I-1,J))*ZZ+ES(I-2,J))*ZZ
     1  +ES(I-3,J))*ZZ+ES(I-4,J))*FNOW/60.
   43 DO 42 LL=1,ISP
      IF (EMSP(LL).NE.IINX ) GO TO 37
      DO 36 K=1,2
      J=INOX(K)
   36 XT(J)=XT(J)+ENOWS(LL)*EXN*FENX(K)
      GO TO 42
   37 IF (EMSP(LL).NE.IIHC  ) GO TO 41
      DO 40 K=1,NHC
      J=IH(K)
   40 XT(J)=XT(J)+ENOWS(LL)*EHC*RCTY(K)/CARB(K)
      GO TO 42
   41 J=IEMLS(LL)
      XT(J)=XT(J)+ENOWS(LL)*ECI(LL)
   42 CONTINUE
C
C  DO PHOTOLYSIS
C
   65 IF (T.EQ.TOLD) GO TO 85
      IF (IP.EQ.0) GO TO 84
      TC=CLOCK(TCI,IFIX(T))
      IF (TC.GT.2400.) TC=TC-2400.
      IF (TC.GE.SSRISE.AND.TC.LE.SSET) GO TO 87
      DO 86 JK=1,IP
      IR=IPH(JK)
      R(IR)=0.
   86 CONTINUE
      ZNOW=90.
      GO TO 84
   87 I=IFIX(T/60.+2.0)
      IF (I.GT.24) I=24
      Z=T/60.-FLOAT(I-2)
      IR=IPH(1)
      R1=(((Z*CF(3*I-3,1)+CF(3*I-4,1))*Z+CF(3*I-5,1))*Z+P(I-1,1))*A(IR)
      IF (R1.LT.0.0) R1=0.
      R(IR)=R1
      DO 80 J=2,IP
      IR=IPH(J)
      IF (PP(1,J).LT.0.) GO TO 75
      R(IR)=((Z*CF(3*I-3,J)+CF(3*I-4,J))*Z+CF(3*I-5,J))*Z+P(I-1,J)
      R(IR)=R(IR)*RFCT(J)*R1
      GO TO 80
   75 CONTINUE
      R(IR)=R1*RFCT(J)
   80 IF (R(IR).LT.0.) R(IR)=0.
      IZ=IFIX(T/60.)+1
      Z=T/60.-FLOAT(IZ-1)
      IF (T.LT.60.) ZNOW=XZ(1)+(0.5*XZ(3)*(Z-1.)+0.5*XZ(1)*(Z-3.)
     1  -XZ(2)*(Z-2.))*Z
      IF (T.GE.60..AND.IZ.LT.23)
     1 ZNOW=XZ(IZ)+0.25*Z*((5.*XZ(IZ+1)-3.*XZ(IZ)-XZ(IZ-1)
     1  -XZ(IZ+2))+(XZ(IZ-1)-XZ(IZ)-XZ(IZ+1)+XZ(IZ+2))*Z)
      IF (IZ.GT.22) ZNOW=(XZ(IZ+1)-XZ(IZ))*Z+XZ(IZ)
C
C     DO TEMPERATURES
C
   84 IF (T.GT.TEMEND) GO TO 85
      IZ=IFIX(T*TINV)+1
      Z=T*TINV-FLOAT(IZ-1)
      IF (T.LE.60.) TNOW=QM(1)+(0.5*QM(3)*(Z-1.)+0.5*QM(1)*(Z-3.)
     1  -QM(2)*(Z-2.))*Z
      IF (T.GT.60.) TNOW=QM(IZ)+0.25*Z*((5.*QM(IZ+1)-3.*QM(IZ)-QM(IZ-1)
     1  -QM(IZ+2))+(QM(IZ-1)-QM(IZ)-QM(IZ+1)+QM(IZ+2))*Z)
      IF (TNOW.NE.TEMP.AND.TNOW.GT.0.) FCT=((3355.7046E-6)*TNOW-1.)/TNO
     1W
C
C     DO SURFACE DEPOSITION
C
   85 IF (T.GE.DPEND) GO TO 89
      FNOW=Z1/HT
      IF (AMIX(1).GE.0.) FNOW=AMIX(1)/HT
      I=IFIX(T/60.)
      Z=(T-FLOAT(I*60))/60.
      I=(I+1)*5
      DO 92 J=1,IDEPO
      DNOWS=((((Z*RDCOEF(I,J)+RDCOEF(I-1,J))*Z+RDCOEF(I-2,J))*Z
     1  +RDCOEF(I-3,J))*Z+RDCOEF(I-4,J))*FNOW/60.
      IF (ISPDP(J).NE.IIHC) GO TO 91
      DO 88 K=1,NHC
      LL=IH(K)
   88 XT(LL)=XT(LL)-DNOWS*X(LL)*RCTY(K)/CARB(K)
      GO TO 92
   91 LL=LOCDEP(J)
      XT(LL)=XT(LL)-DNOWS*X(LL)
   92 CONTINUE
C
```

```
C  DO REACTION RATES .
C
   89 DO 110 IR=1,NR
      I=KR(IR,1)
      IF (I.EQ.0.OR.R(IR).EQ.0.) GO TO 110
      RT=1.
      JT=ITYPE(IR)
      DO 90 LL=1,JT
      I=KR(IR,LL)
      IF (I.NE.99.AND.I.NE.0) RT=RT*X(I)
   90 CONTINUE
      IF (ABS(S(IR)).NE.0.) R(IR)=A(IR)*EXP(S(IR)*FCT)
      RT=RT*R(IR)
      DO 95 LL=1,JT
      I=KR(IR,LL)
      IF (I.NE.0) XT(I)=XT(I)-RT
   95 CONTINUE
      DO 100 K=4,12
      I=KR(IR,K)
      IF (I.EQ.0) GO TO 110
  100 XT(I)=XT(I)+SC(IR,K)*RT
  110 CONTINUE
      TOLD=T
      TEMP=TNOW
      ZENI=ZNOW
      RETURN
C     ENTRY DIFSET
 2000 CONTINUE
      TOLD=T
      TINV=1./60.
      FCT=((3355.7046E-6)*TEMP-1.)/TEMP
      IOLD=0
      TCI=FLOAT(JSRT)
      DHC=HCAL-HCBK
      DXN=XNAL-XNBK
      DO3=OZAL-OZBK
      IF (DHC.LT.0.) HCAL=HCBK
      IF (DXN.LT.0.) DXN=0.
      IF (DO3.LT.0.) DO3=0.
      HT=AMIX(1)
      IF (HT.LT.0.) HT=AMXX(1)
      IF (IP.EQ.0) RETURN
      II=0
      DO 125 J=1,IP
      IR=IPH(J)
      R(IR)=P(1,J)*RFCT(J)
      IF (J.GT.1) R(IR)=R(IR)*R(1)
      IF (R(IR).LT.0.) R(IR)=0.
  125 CONTINUE
      ZENI=XZ(1)
      RETURN                                                            AA  251
      END                                                               AA  252-
      SUBROUTINE COSET (METH,NQ,EL,TQ,MAXDER)
      DIMENSION PERTST(12,2,3), EL(13), TQ(4)
      DATA PERTST/1.,1.,2.,1.,.3158,.07407,.01391,.002182,.0002945,.0000
     13492,.000003692,.0000003524,1.,1.,.5,.1667,.04167,1.,1.,1.,1.,1.,1
     2.,1.,2.,12.,24.,37.89,53.33,70.08,87.97,106.9,126.7,147.4,168.8,19
     31.0,2.0,4.5,7.333,10.42,13.7,1.,1.,1.,1.,1.,1.,1.,12.0,24.0,37.89,
     453.33,70.08,87.97,106.9,126.7,147.4,168.8,191.0,1.,3.0,6.0,9.167,1
     52.5,1.,1.,1.,1.,1.,1.,1.,1./
    5 MAXDER=5
      GO TO (10,15,20,25,30),NQ
   10 EL(1)=1.0
      GO TO 35
   15 EL(1)=6.6666666666667E-01
      EL(3)=3.3333333333333E-01
      GO TO 35
   20 EL(1)=5.4545454545455E-01
      EL(3)=EL(1)
      EL(4)=9.0909090909091E-02
      GO TO 35
   25 EL(1)=0.48
      EL(3)=0.7
      EL(4)=0.2
      EL(5)=0.02
      GO TO 35
   30 EL(1)=4.3795620437956E-01
      EL(3)=8.2116788321168E-01
      EL(4)=3.1021897810219E-01
      EL(5)=5.4744525547445E-02
      EL(6)=3.6496350364964E-03
   35 DO 40 K=1,3
   40 TQ(K)=PERTST(NQ,METH,K)
      TQ(4)=.5*TQ(2)/FLOAT(NQ+2)
      RETURN
      END
      FUNCTION CLKMIN (X)                                              AC    1
      JSTRT=IFIX(X+0.1)                                                AC    2
      JMIN=JSTRT-((JSTRT/100)*100)                                     AC    3
      CLKMIN=FLOAT((JSTRT/100)*60+JMIN)                                AC    4
      RETURN                                                           AC    5
      END                                                              AC    6-
      SUBROUTINE CURV1 (N,X,Y,SLP1,SLPN,YP,TEMP,SIGMA)
C
C    THIS SUBROUTINE DETERMINES THE PARAMETERS NECESSARY TO
C    COMPUTE AN INTERPOLATORY SPLINE UNDER TENSION THROUGH
C    A SEQUENCE OF FUNCTIONAL VALUES.  THE SLOPES AT THE TWO
C    ENDS OF THE CURVE MAY BE SPECIFIED OR OMITTED.  FOR ACTUAL
C    COMPUTATION OF POINTS ON THE CURVE IT IS NECESSARY TO CALL
C    THE FUNCTION CURV2.
C
C    ON INPUT --
C    N = THE NUMBER OF VALUES TO BE INTERPOLATED (N.GE.2),
C    X = AN ARRAY OF THE N INCREASING ABCISSAE OF THE
C        FUNCTIONAL VALUES,
C    Y = AN ARRAY OF THE N ORDINATES OF THE VALUES, (I.E.Y(K)
C        IS THE FUNCTIONAL VALUE CORRESPONDING TO X(K)),
C    SLP1,SLPN CONTAIN THE DESIRED VALUES FOR THE FIRST
C        DERIVATIVE TO THE CURVE AT X(1) AND X(N), RESPECTIVELY,
C        IF THE QUANTITY SIGMA IS NEGATIVE THESE VALUES WILL BE
C        DETERMINED INTERNALLY AND THE USER NEED ONLY FURNISH
C        PLACE-HOLDING PARAMETERS FOR SLP1 AND SLPN.  SUCH PLACE-
C        HOLDING PARAMETERS WILL BE IGNORED BY NOT DESTROYED,
C    YP = AN ARRAY OF LENGTH AT LEAST N
C    TEMP = AN ARRAY OF LENGTH AT LEAST N WHICH IS USED FOR
C        SCRATCH STORAGE,
C    SIGMA = THE TENSION FACTOR.  THIS IS NON-ZERO AND
C        INDICATES THE CURVINESS DESIRED. IF ABS(SIGMA) IS NEARLY
C        ZERO (E.G. .001) THE RESULTING CURVE IS APPROXIMATELY A
C        CUBIC SPLINE.  IF ABS(SIGMA) IS LARGE (E.G. 50.) THE
C        RESULTING CURVE IS NEARLY A POLYGONAL LINE.  THE SIGN
C        OF SIGMA INDICATES WHETHER THE DERIVATIVE INFORMATION
C        HAS BEEN INPUT OR NOT.  IF SIGMA IS NEGATIVE THE ENDPOINT
C        DERIVATIVES WILL BE DETERMINED INTERNALLY.  A STANDARD
C        VALUE FOR SIGMA IS APPROXIMATELY 1. IN ABSOLUTE VALUE
C
C    ON OUTPUT --
C    YP = VALUES PROPORTIONAL TO THE SECOND DERIVATIVE
C        OF THE CURVE AT THE GIVEN NODES.
C    N,X,Y,SLP1 AND SIGMA ARE UNALTERED,
C
C     *** AK CLINE/NCAR, COMM. ACM 17,4(APR.1974), 221.
C
      DIMENSION X(N), Y(N), YP(N), TEMP(N)
      DATA EXPMAX/87.4/
C
      NCYC=0
      NCHG=0
      NM1=N-1
      NP1=N+1
      DELX1=X(2)-X(1)
      IF (ABS(DELX1/X(2)).LT.0.02) GO TO 55
      DX1=(Y(2)-Y(1))/DELX1
C
C     *** DETERMINE SLOPES IF NECESSARY
      IF (SIGMA.LT.0.) GO TO 45
      SLPP1=SLP1
      SLPPN=SLPN
C
C     *** DENORMALIZE TENSION FACTOR
    5 IF (ABS(X(N)-X(1))/X(N).LT.0.02) GO TO 55
      SIGMAP=ABS(SIGMA)*FLOAT(N-1)/(X(N)-X(1))
      DX1=(Y(2)-Y(1))/DELX1
C
C     *** SET UP RIGHT HAND SIDE OF TRIDIAGONAL SYSTEM
C         FOR YP AND PERFORM FORWARD ELIMINATION
      DELS=SIGMAP*DELX1
      IF (ABS(DELS).GE.EXPMAX) GO TO 55
      EXPS=EXP(DELS)
      SINHS=0.5*(EXPS-1./EXPS)
      SINHIN=1./(DELX1*SINHS)
      DIAG1=SINHIN*(DELS*0.5*(EXPS+1./EXPS)-SINHS)
      DIAGIN=1./DIAG1
      YP(1)=DIAGIN*(DX1-SLPP1)
      SPDIAG=SINHIN*(SINHS-DELS)
      TEMP(1)=DIAGIN*SPDIAG
      IF (N.EQ.2) GO TO 15
      DO 10 I=2,NM1
      DELX2=X(I+1)-X(I)
      IF (ABS(DELX2)/X(I+1).LT.0.02) GO TO 55
      DX2=(Y(I+1)-Y(I))/DELX2
      DELS=SIGMAP*DELX2
      IF (ABS(DELS).GE.EXPMAX) GO TO 55
      EXPS=EXP(DELS)
      SINHS=.5*(EXPS-1./EXPS)
      SINHIN=1./(DELX2*SINHS)
      DIAG2=SINHIN*(DELS*(.5*(EXPS+1./EXPS))-SINHS)
      DIAGIN=1./(DIAG1+DIAG2-SPDIAG*TEMP(I-1))
      YP(I)=DIAGIN*(DX2-DX1-SPDIAG*YP(I-1))
      SPDIAG=SINHIN*(SINHS-DELS)
      TEMP(I)=DIAGIN*SPDIAG
      DX1=DX2
      DIAG1=DIAG2
   10 CONTINUE
   15 DIAGIN=1./(DIAG1-SPDIAG*TEMP(NM1))
      YP(N)=DIAGIN*(SLPPN-DX2-SPDIAG*YP(NM1))
C
C     ***  PERFORM BACK SUBSTITUTION
      DO 20 I=2,N
      IBAK=NP1-I
      YP(IBAK)=YP(IBAK)-TEMP(IBAK)*YP(IBAK+1)
   20 CONTINUE
```

```
      IF (SIGMA.GT.0.) RETURN
      IF (N.EQ.3) RETURN
      IF (NCYC.GT.15) RETURN
      IF (NCYC.GT.0) GO TO 25
      XTEST=(X(3)+X(2))/2.
      YCORD=(Y(3)+Y(2))/2.
      FACT=SQRT(ABS(SIGMA))
      YTEST=(YCORD*FACT+CIRC(XTEST,X(1),Y(1))+CIRC(XTEST,X(2),Y(2)))/(2.
     1+FACT)
      DY2=CURV2(XTEST,N,X,Y,YP,SIGMA,1)-YTEST
      DSAV=DY2
      SN=-1.
      IF (DY2.GT.0.) SN=1.
      FACT=0.3*(SN+2.)
      DY2=0.
      IT=1
   25 NCYC=NCYC+1
      DY1=DY2
      DY2=CURV2(XTEST,N,X,Y,YP,SIGMA,IT)-YTEST
      IF (NCYC.GT.15) RETURN
      IF (NCYC.GT.13.AND.NCHG.LT.2) GO TO 40
      IF (SIGN(1.,DY1).NE.SIGN(1.,DY2)) GO TO 30
      IF (ABS(DY2).LT.ABS(DY1)) GO TO 35
   30 SN=-SN
      NCHG=NCHG+1
      FACT=SN*((1./(1.-SN*FACT))**(1./3.)-1.)
   35 SLPP1=SLPP1*(1.+SN*FACT)
      GO TO 5
C
   40 IF (DY2/DSAV.LT.0.2) GO TO 35
      SLPP1=SLPPX
      NCYC=15
      GO TO 5
   45 IF (N.EQ.2) GO TO 50
C
C     *** IF NO DERIVATIVES ARE GIVEN USE SECOND ORDER POLYNOMIAL
C         INTERPOLATION ON INPUT DATA FOR VALUES AT ENDPOINTS.
      SLPP1=(Y(2)-Y(1))/(X(2)-X(1))
      DELN=X(N)-X(NM1)
      DELNM1=X(NM1)-X(N-2)
      DELNN=X(N)-X(N-2)
      IF (ABS(DELN)/X(N).LT.0.02) GO TO 55
      IF (ABS(DELN)/X(N).LT.0.02) GO TO 55
      IF (ABS(DELNM1)/X(NM1).LT.0.02) GO TO 55
      IF (ABS(DELNN)/X(N).LT.0.02) GO TO 55
      C1=(DELNN+DELN)/DELNN/DELN
      C2=-DELNN/DELN/DELNM1
      C3=DELN/DELNN/DELNM1
      SLPPN=C3*Y(N-2)+C2*Y(NM1)+C1*Y(N)
      DX2=X(3)-X(2)
      DX31=X(3)-X(1)
      IF (ABS(DX2)/X(3).LT.0.02) GO TO 55
      IF (ABS(DX31)/X(3).LT.0.02) GO TO 55
      C1=-(DX31+DELX1)/DX31/DELX1
      C2=DX31/DELX1/DX2
      C3=-DELX1/DX31/DX2
      SLPPX=C1*Y(1)+C2*Y(2)+C3*Y(3)
      IF (Y(2).GT.Y(1)) SLPPX=AMAX1(0.,SLPPX)
      FACT2=SQRT(ABS(SIGMA))
      SLPPX=(SLPPX+FACT2*SLPP1)/(1.+FACT2)
      SLPP1=SLPPX
      IF (Y(N).GT.Y(NM1)) SLPPN=AMAX1(0.,SLPPN)
      SLPNL=(Y(N)-Y(NM1))/DELN
      SLPPN=(SLPPN+SLPNL*FACT2)/(1.+FACT2)
      SLPPN=(SLPPN-SLPNL*SIGMA)/(1.-SIGMA)
      GO TO 5
C
C     *** IF ONLY TWO POINTS AND NO DERIVATIVES ARE GIVEN, USE
C         STRAIGHT LINE FOR CURVE
C
   50 YP(1)=0.
      YP(2)=0.
      RETURN
   55 SIGMA=-50.
      RETURN
      END
      FUNCTION CURV2 (T,N,X,Y,YP,SIGMA,IT)
C
C     THIS FUNCTION INTERPOLATES A CURVE AT A GIVEN POINT
C     USING A SPLINE UNDER TENSION.  THE SUBROUTINE CURV1 SHOULD
C     BE CALLED EARLIER TO DETERMINE CERTAIN NECESSARY
C     PARAMETERS.
C
C     ON INPUT--
C     T = A REAL VALUE TO BE MAPPED ONTO THE
C         INTERPOLATING CURVE.
C     N = THE NUMBER OF POINTS WHICH WERE INTERPOLATED
C         TO DETERMINE THE CURVE,
C     X,Y = ARRAYS CONTAINING THE ORDINATES AND ABCISSAS
C         OF THE INTERPOLATED POINTS,
C     YP = AN ARRAY WITH VALUES PROPORTIONAL TO THE SECOND
C         DERIVATIVE OF THE CURVE AT THE NODES
C     SIGMA = THE TENSION FACTOR (ITS SIGN IS IGNORED)
C         IT IS AN INTEGER SWITCH.  IF IT IS NOT 1 THIS INDICATES
C         THAT THE FUNCTION HAS BEEN CALLED PREVIOUSLY (WITH N,X,
C         Y,YP, AND SIGMA UNALTERED) AND THAT THIS VALUE OF T
C         EXCEEDS THE PREVIOUS VALUE.  WITH SUCH INFORMATION THE
C         FUNCTION IS ABLE TO PERFORM THE INTERPOLATION MUCH MORE
C         RAPIDLY.  IF A USER SEEKS TO INTERPOLATE AT A SEQUENCE
C         OF POINTS, EFFICIENCY IS GAINED BY ORDERING THE VALUES
C         INCREASING AND SETTING IT TO THE INDEX OF THE CALL.
C         IF IT IS 1 THE SEARCH FOR THE INTERVAL (X(K),X(K+1))
C         CONTAINING T STARTS WITH K=1.
C         THE PARAMETERS N,X,Y,YP AND SIGMA SHOULD BE INPUT
C         UNALTERED FROM THE OUTPUT OF CURV1.
C
C     ON OUTPUT--
C     CURV2 = THE INTERPOLATED VALUE.  FOR T LESS THAN
C         X(1) CURV2 = Y(1).  FOR T GREATER THAN X(N) CURV2 = Y(N).
C
C     NONE OF THE INPUT PARAMETERS ARE ALTERED.
C
C      *** AK CLINE/NCAR, COMM. ACM 17,4(APR.1974), 221
C
       DIMENSION X(N), Y(N), YP(N)
       DATA EXPMAX/80.2/
C
       S=X(N)-X(1)
       IT=IABS(IT)
C
C      *** DENORMALIZE SIGMA
       SIGMAP=ABS(SIGMA)*FLOAT(N-1)/S
C
C      *** IF IT.NE. 1 START SEARCH WHERE PREVIOUSLY TERMINATED,
C          OTHERWISE START SEARCH FROM BEGINNING
       IF (IT.EQ.1) I1=2
```

```
C
C     *** SEARCH FOR INTERVAL
    5 DO 10 I=I1,N
      IF (X(I)-T) 10,10,15
   10 CONTINUE
      I=N
C
C     *** CHECK TO INSURE CORRECT INTERVAL
   15 IF (X(I-1).LE.T.OR.T.LE.X(1)) GO TO 20
C
C     *** RESTART SEARCH AND RESET I1
C            (INPUT (IT( WAS INCORRECT)
      I1=2
      GO TO 5
C
C     *** SET UP AND PERFORM INTERPOLATION
   20 IF (SIGMA.EQ.(-50.)) GO TO 25
      DEL1=T-X(I-1)
      DEL2=X(I)-T
      DELS=X(I)-X(I-1)
      EXPTST=SIGMAP*DEL1
      IF (ABS(EXPTST).GT.EXPMAX.AND.EXPTST.LT.0.) EXPTST=-EXPMAX
      IF (ABS(EXPTST).GT.EXPMAX.AND.EXPTST.GT.0.) EXPTST=EXPMAX
      EXPS1=EXP(EXPTST)
      SINHD1=.5*(EXPS1-1./EXPS1)
      EXPTST=SIGMAP*DEL2
      IF (ABS(EXPTST).GT.EXPMAX.AND.EXPTST.LT.0.) EXPTST=-EXPMAX
      IF (ABS(EXPTST).GT.EXPMAX.AND.EXPTST.GT.0.) EXPTST=EXPMAX
      EXPS=EXP(EXPTST)
      SINHD2=.5*(EXPS-1./EXPS)
      ALN1=ALOG(ABS(EXPS1))
      ALN2=ALOG(ABS(EXPS))
      IF (ABS(ALN1+ALN2).GT.EXPMAX.AND.EXPS.GT.1.E-10) EXPS=EXP(EXPMAX)
      IF (ABS(ALN1+ALN2).GT.EXPMAX.AND.EXPS.LT.1.E-10)
     1      EXPS=EXP(-EXPMAX)
      IF (ABS(ALN1+ALN2).LT.EXPMAX) EXPS=EXPS1*EXPS
      SINHS=.5*(EXPS-1./EXPS)
      CURV2=(YP(I)*SINHD1+YP(I-1)*SINHD2)/SINHS+((Y(I)-YP(I))*DEL1+(Y(I-
     11)-YP(I-1))*DEL2)/DELS
      IF ((ABS(Y(I)-CURV2)+ABS(Y(I-1)-CURV2)).GT.1.001*(ABS(Y(I)-Y(I-1))
     1)) IT=-IT
      I1=I
      RETURN
   25 IF (ABS(X(I)-X(I-1))/X(I).LT.0.02) I=I+1
      IF (I.GT.N) I=I-2
      CURV2=((T-X(I-1))*(Y(I)-Y(I-1))/(X(I)-X(I-1)))+Y(I-1)
      IT=1
      RETURN
      END
      SUBROUTINE EDGMX (X,Y,N,XMX,YMX,L)
      DIMENSION X(N), Y(N)
      LL=N-1
      IF (N.LE.2) GO TO 10
      NGO=0
      DO 5 I=2,LL
      IF (Y(I).GT.Y(I-1)) GO TO 5
      IF (Y(I).GT.Y(I+1)) L=I+1
      IF (Y(I).GT.Y(I+1)) NGO=1
      GO TO 6
    5 CONTINUE
    6 CONTINUE
      IF (NGO.EQ.1) GO TO 15
   10 XMX=X(N)
      YMX=Y(N)
      L=N-1
      RETURN
   15 L=MAX0(L-1,3)
      X21=X(L-1)-X(L-2)
      X221=X(L-1)*X(L-1)-X(L-2)*X(L-2)
      X32=X(L)-X(L-1)
      XL2=X(L)*X(L)
      Y21=Y(L-1)-Y(L-2)
      C=(Y21/X21-(Y(L)-Y(L-1))/X32)/(X221/X21-(XL2-X(L-1)*X(L-1))/X32)
      B=(Y21-C*X221)/X21
      A=Y(L)-B*X(L)-C*XL2
      XMX=-B*0.5/C
      YMX=A+B*XMX+C*XMX*XMX
      IF (XMX.GE.0.999*X(L)) YMX=Y(L)
      IF (YMX.EQ.Y(L)) XMX=X(L)
      IF (XMX.LT.1.001*X(L-2).AND.L.GT.3) GO TO 15
      L=L-1
      IF (XMX.LE.X(L)) L=L-1
      RETURN
      END
      SUBROUTINE INTERP (TOUT,Y,NO,YO)
      COMMON /GEAR1/ T,H,DUMMY(4),N,IDUMMY(2),JSTART
      DIMENSION YO(NO), Y(NO,1)
      DO 5 I=1,N
    5 YO(I)=Y(I,1)
      L=JSTART+1
      S=(TOUT-T)/H
      S1=1.
      DO 15 J=2,L
      S1=S1*S
      DO 10 I=1,N
   10 YO(I)=YO(I)+S1*Y(I,J)
   15 CONTINUE
      RETURN
      END
      SUBROUTINE NSBSLV (N,R,C,IL,JL,ISL,L,D,IU,JU,ISU,U,X,B,Y)
      DIMENSION R(1), IL(1), JL(1), IU(1), JU(1), C(1), ISL(1), ISU(1)
      DIMENSION L(1), X(1), B(1), U(1), Y(1), D(1)
      INTEGER R,RK,C,CK
      REAL L
      DO 5 K=1,N
      RK=R(K)
    5 Y(K)=B(RK)
      DO 15 K=1,N
      JMIN=IL(K)
      JMAX=IL(K+1)-1
      YK=-D(K)*Y(K)
      Y(K)=-YK
      IF (JMIN.GT.JMAX) GO TO 15
      ISLB=ISL(K)-1
      DO 10 J=JMIN,JMAX
      ISLB=ISLB+1
      JLJ=JL(ISLB)
   10 Y(JLJ)=Y(JLJ)+YK*L(J)
   15 CONTINUE
      K=N
      DO 30 I=1,N
      SUM=-Y(K)
      JMIN=IU(K)
      JMAX=IU(K+1)-1
      IF (JMIN.GT.JMAX) GO TO 25
      ISUB=ISU(K)-1
      DO 20 J=JMIN,JMAX
      ISUB=ISUB+1
      JUJ=JU(ISUB)
   20 SUM=SUM+U(J)*Y(JUJ)
   25 Y(K)=-SUM
      CK=C(K)
      X(CK)=-SUM
   30 K=K-1
      RETURN
      END
      SUBROUTINE NSCORA (N,IA,JA,A,IAP,JAWORK,AWORK,C,IR,ICT)
      INTEGER IA(1),JA(1),IAP(1),JAWORK(1),C(1),IR(1),ICT(1)
      REAL A(1),AWORK(1)
      DO 5 K=1,N
      ICK=C(K)
    5 IR(ICK)=K
      JMIN=1
      DO 15 K=1,N
      ICK=C(K)
      JMAX=JMIN+IA(ICK+1)-IA(ICK)-1
      IF (JMIN.GT.JMAX) GO TO 15
      IAINK=IA(ICK)-1
      DO 10 J=JMIN,JMAX
      IAINK=IAINK+1
      JAOUTJ=JA(IAINK)
      JAOUTJ=IR(JAOUTJ)
      JAWORK(J)=JAOUTJ
   10 AWORK(J)=A(IAINK)
   15 JMIN=JMAX+1
      DO 20 I=1,N
   20 ICT(I)=IAP(I)
      JMIN=1
      DO 30 I=1,N
      ICK=C(I)
      JMAX=JMIN+IA(ICK+1)-IA(ICK)-1
      IF (JMIN.GT.JMAX) GO TO 30
      DO 25 J=JMIN,JMAX
      JAOUTJ=JAWORK(J)
      ICTJ=ICT(JAOUTJ)
      A(ICTJ)=AWORK(J)
      ICT(JAOUTJ)=ICTJ+1
   25 CONTINUE
   30 JMIN=JMAX+1
      RETURN
      END
      SUBROUTINE NSCORD (N,IA,JA,IAWORK,JAWORK,C,IR,ICT)
      INTEGER IA(1),JA(1),IAWORK(1),JAWORK(1),C(1),IR(1),ICT(1)
      DO 5 I=1,N
    5 ICT(I)=0
      IAWORK(1)=1
      DO 15 K=1,N
      ICK=C(K)
      JMIN=IAWORK(K)
      JMAX=JMIN+IA(ICK+1)-IA(ICK)-1
      IAWORK(K+1)=JMAX+1
      IF (JMIN.GT.JMAX) GO TO 15
      IAINK=IA(ICK)-1
      DO 10 J=JMIN,JMAX
      IAINK=IAINK+1
      JAOUTJ=JA(IAINK)
      JAOUTJ=IR(JAOUTJ)
      JAWORK(J)=JAOUTJ
   10 ICT(JAOUTJ)=ICT(JAOUTJ)+1
   15 CONTINUE
      IA(1)=1
      DO 20 I=1,N
      IA(I+1)=IA(I)+ICT(I)
   20 ICT(I)=IA(I)
      DO 30 I=1,N
      JMIN=IAWORK(I)
      JMAX=IAWORK(I+1)-1
      IF (JMIN.GT.JMAX) GO TO 30
      DO 25 J=JMIN,JMAX
      JAOUTJ=JAWORK(J)
      ICTJ=ICT(JAOUTJ)
      JA(ICTJ)=I
   25 ICT(JAOUTJ)=ICTJ+1
   30 CONTINUE
      RETURN
      END
      SUBROUTINE NSNFAC (N,IA,JA,A,IL,JL,ISL,L,D,IU,JU,ISU,U,X,IRL,JRL,I
     1ER)
      INTEGER IA(1),JA(1),IL(1),JL(1),ISL(1)
      INTEGER IU(1),JU(1),ISU(1),IRL(1),JRL(1)
      REAL A(1),L(1),D(1),U(1),X(1)
      REAL LKI
      IER=0
      DO 5 K=1,N
      IRL(K)=IL(K)
    5 JRL(K)=0
      DO 90 K=1,N
      X(K)=0.
      I1=0
      IF (JRL(K).EQ.0) GO TO 15
      I=JRL(K)
   10 I2=JRL(I)
      JRL(I)=I1
      I1=I
      X(I)=0.
      I=I2
      IF (I.NE.0) GO TO 10
   15 JMIN=ISU(K)
      JMAX=JMIN+IU(K+1)-IU(K)-1
      IF (JMIN.GT.JMAX) GO TO 25
      DO 20 J=JMIN,JMAX
      JUJ=JU(J)
   20 X(JUJ)=0.
   25 JMIN=IA(K)
      JMAX=IA(K+1)-1
      DO 30 J=JMIN,JMAX
      JAJ=JA(J)
   30 X(JAJ)=A(J)
      I=I1
      IF (I.EQ.0) GO TO 50
   35 IRLI=IRL(I)
      LKI=-X(I)
      L(IRLI)=-LKI
      JMIN=IU(I)
      JMAX=IU(I+1)-1
      IF (JMIN.GT.JMAX) GO TO 45
      ISUB=ISU(I)-1
      DO 40 J=JMIN,JMAX
      ISUB=ISUB+1
      JUJ=JU(ISUB)
   40 X(JUJ)=X(JUJ)+LKI*U(J)
   45 I=JRL(I)
      IF (I.NE.0) GO TO 35
   50 IF (X(K).EQ.0.) GO TO 95
      DK=1./X(K)
      D(K)=DK
      IF (K.EQ.N) GO TO 90
      JMIN=IU(K)
      JMAX=IU(K+1)-1
      IF (JMIN.GT.JMAX) GO TO 60
      ISUB=ISU(K)-1
      DO 55 J=JMIN,JMAX
      ISUB=ISUB+1
      JUJ=JU(ISUB)
   55 U(J)=X(JUJ)*DK
   60 CONTINUE
      I=I1
      IF (I.EQ.0) GO TO 85
   65 IRL(I)=IRL(I)+1
      I1=JRL(I)
      IF (IRL(I).GE.IL(I+1)) GO TO 80
      ISLB=IRL(I)-IL(I)+ISL(I)
      J=JL(ISLB)
   70 IF (I.GT.JRL(J)) GO TO 75
      J=JRL(J)
      GO TO 70
   75 JRL(I)=JRL(J)
      JRL(J)=I
   80 I=I1
      IF (I.NE.0) GO TO 65
   85 ISLK=ISL(K)
      IF (IRL(K).GE.IL(K+1)) GO TO 90
      J=JL(ISLK)
      JRL(K)=JRL(J)
      JRL(J)=K
   90 CONTINUE
      RETURN
   95 IER=K
      RETURN
      END
      SUBROUTINE NSSFAC (N,IA,JA,MAXPL,IL,JL,ISL,MAXPU,IU,JU,ISU,P,V,IRA
     1,JRA,IRAC,IRL,JRL,IRU,JRU,IER)
      INTEGER IA(1),JA(1),IRA(1),JRA(1),IL(1),JL(1),ISL(1)
      INTEGER IU(1),JU(1),ISU(1),IRL(1),JRL(1),IRU(1),JRU(1)
      INTEGER P(1),V(1),IRAC(1)
      INTEGER VI,VJ,VK,PK,PPK,PI,CEND,REND
      IER=0
      DO 5 K=1,N
      IRAC(K)=0
      JRA(K)=0
      JRL(K)=0
    5 JRU(K)=0
      DO 10 K=1,N
      IAK=IA(K)
      IF (IAK.GT.IA(K+1)) GO TO 200
      IF (JA(IAK).GT.K) GO TO 10
      JAIAK=JA(IAK)
      JRA(K)=IRAC(JAIAK)
      IRAC(JAIAK)=K
   10 IRA(K)=IAK
      JLPTR=0
      IL(1)=1
      JUPTR=0
      IU(1)=1
      DO 195 K=1,N
      P(1)=1
      V(1)=N+1
      LSFS=2
      VJ=IRAC(K)
      IF (VJ.EQ.0) GO TO 30
   15 PPK=1
   20 PK=PPK
      PPK=P(PK)
      IF (V(PPK)-VJ) 20,220,25
   25 P(PK)=LSFS
      V(LSFS)=VJ
      P(LSFS)=PPK
      LSFS=LSFS+1
      VJ=JRA(VJ)
      IF (VJ.NE.0) GO TO 15
   30 LASTI=0
      I=K
   35 I=JRU(I)
      IF (I.EQ.0) GO TO 60
      PPK=1
      JMIN=IRL(I)
      JMAX=ISL(I)+IL(I+1)-IL(I)-1
      IF (LASTI.GT.I) GO TO 40
      LASTI=I
      LASTID=JMAX-JMIN
      IF (JL(JMIN).NE.K) LASTID=LASTID+1
   40 IF (JMIN.GT.JMAX) GO TO 35
      DO 55 J=JMIN,JMAX
      VJ=JL(J)
   45 PK=PPK
      PPK=P(PK)
      IF (V(PPK)-VJ) 45,55,50
   50 P(PK)=LSFS
      V(LSFS)=VJ
      P(LSFS)=PPK
      PPK=LSFS
      LSFS=LSFS+1
   55 CONTINUE
      GO TO 35
   60 PI=P(1)
      IF (V(PI).NE.K) GO TO 225
      IF (LASTI.EQ.0) GO TO 65
      IF (LASTID.NE.LSFS-3) GO TO 65
      IRLL=IRL(LASTI)
      ISL(K)=IRLL+1
      IF (JL(IRLL).NE.K) ISL(K)=ISL(K)-1
      IL(K+1)=IL(K)+LASTID
      IRL(K)=ISL(K)
      GO TO 80
   65 ISL(K)=JLPTR+1
      PI=P(1)
      PI=P(PI)
      VI=V(PI)
   70 IF (VI.GT.N) GO TO 75
      JLPTR=JLPTR+1
      IF (JLPTR.GT.MAXPL) GO TO 230
      JL(JLPTR)=VI
      PI=P(PI)
      VI=V(PI)
      GO TO 70
   75 IRL(K)=ISL(K)
      IL(K+1)=IL(K)+JLPTR-ISL(K)+1
   80 P(1)=1
      V(1)=N+1
      LSFS=2
      JMIN=IRA(K)
      JMAX=IA(K+1)-1
      IF (JMIN.GT.JMAX) GO TO 100
      DO 95 J=JMIN,JMAX
      VJ=JA(J)
      PPK=1
   85 PK=PPK
      PPK=P(PK)
      IF (V(PPK)-VJ) 85,205,90
   90 P(PK)=LSFS
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      V(LSFS)=VJ
      P(LSFS)=PPK
   95 LSFS=LSFS+1
  100 LASTI=0
      I=K
  105 I=JRL(I)
      IF (I.EQ.0) GO TO 130
      PPK=1
      JMIN=IRU(I)
      JMAX=ISU(I)+IU(I+1)-IU(I)-1
      IF (LASTI.GT.I) GO TO 110
      LASTI=I
      LASTID=JMAX-JMIN
      IF (JU(JMIN).NE.K) LASTID=LASTID+1
  110 IF (JMIN.GT.JMAX) GO TO 105
      DO 125 J=JMIN,JMAX
      VJ=JU(J)
  115 PK=PPK
      PPK=P(PK)
      IF (V(PPK)-VJ) 115,125,120
  120 P(PK)=LSFS
      V(LSFS)=VJ
      P(LSFS)=PPK
      PPK=LSFS
  125 LSFS=LSFS+1
      GO TO 105
  130 PI=P(1)
      IF (V(PI).NE.K) GO TO 210
      IF (LASTI.EQ.0) GO TO 135
      IF (LASTID.NE.LSFS-3) GO TO 135
      IRUL=IRU(LASTI)
      ISU(K)=IRUL+1
      IF (JU(IRUL).NE.K) ISU(K)=ISU(K)-1
      IU(K+1)=IU(K)+LASTID
      IRU(K)=ISU(K)
      GO TO 150
  135 ISU(K)=JUPTR+1
      PI=P(1)
      PI=P(PI)
      VI=V(PI)
  140 IF (VI.GT.N) GO TO 145
      JUPTR=JUPTR+1
      IF (JUPTR.GT.MAXPU) GO TO 215
      JU(JUPTR)=VI
      PI=P(PI)
      VI=V(PI)
      GO TO 140
  145 IRU(K)=ISU(K)
      IU(K+1)=IU(K)+JUPTR-ISU(K)+1
  150 I=K
  155 I1=JRL(I)
      CEND=ISL(I)+IL(I+1)-IL(I)
      IF (IRL(I).GE.CEND) GO TO 160
      IRLI=IRL(I)
      J=JL(IRLI)
      JRL(I)=JRL(J)
      JRL(J)=I
  160 I=I1
      IF (I.EQ.0) GO TO 165
      IRL(I)=IRL(I)+1
      GO TO 155
  165 I=K
  170 I1=JRU(I)
      REND=ISU(I)+IU(I+1)-IU(I)
      IF (IRU(I).GE.REND) GO TO 175
      IRUI=IRU(I)
      J=JU(IRUI)
      JRU(I)=JRU(J)
      JRU(J)=I
  175 I=I1
      IF (I.EQ.0) GO TO 180
      IRU(I)=IRU(I)+1
      GO TO 170
  180 I=IRAC(K)
      IF (I.EQ.0) GO TO 195
  185 I1=JRA(I)
      IRA(I)=IRA(I)+1
      IF (IRA(I).GE.IA(I+1)) GO TO 190
      IRAI=IRA(I)
      IF (JA(IRAI).GT.I) GO TO 190
      JAIRAI=JA(IRAI)
      JRA(I)=IRAC(JAIRAI)
      IRAC(JAIRAI)=I
  190 I=I1
      IF (I.NE.0) GO TO 185
  195 CONTINUE
      ISL(N)=JLPTR
      ISU(N)=JUPTR
      RETURN
  200 CALL YSMER (3HROW,K,13H OF A IS NULL)
      GO TO 235
  205 CALL YSMER (3HROW,K,20H HAS DUPLICATE ENTRY)
      GO TO 235
  210 CALL YSMER (3HROW,K,17H HAS A NULL PIVOT)
      GO TO 235
  215 CALL YSMER (3HROW,K,19H EXCEEDS JU STORAGE)
      GO TO 235
  220 CALL YSMER (3HCOL,K,20H HAS DUPLICATE ENTRY)
      GO TO 235
  225 CALL YSMER (3HCOL,K,17H HAS A NULL PIVOT)
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      GO TO 235                                                         AL  201
  230 CALL YSMER (3HCOL,K,19H EXCEEDS JL STORAGE)                       AL  202
  235 IER=1                                                             AL  203
      RETURN                                                            AL  204
      END                                                               AL  205-
      SUBROUTINE OZMX(C,TLL,TOUT,NO)
C
      DIMENSION C(NO,6), RUN(61,5), OZ(61,5), OZA(5), TL(5), NT(5)
      DIMENSION S2(5),SIX(5)
      COMMON /GEAR1/ T,H,HMIN,HMAX,EPSC,UROUND,NC,MFC,KFLAG,JSTART
      COMMON /HOUR/ OZM(5),NGO,TTM,TM(5)
      COMMON /CALC/ NR,KR(200,12),A(200),S(200),R(200),ITYPE(200),IA(90)
     1,JA(1500),DILUT,TEMP,ERR,START,STOPP,SPECIS(91),TPRNT,TSTEP,ZENI
      COMMON /SPEC/ NS,HCSPEC(15),CARB(15),RCTY(15),XNF(2),IH(15),
     1INOX(2),FINHC(15),FALHC(15),NHC,OZIN,OZAL,HCIN,HCAL,XNIN,XNAL,
     2NOZ,FENX(2),CR(91),REACT(91),NI,PLSP(5),JOZ(5)
      INTEGER SPECIS,HCSPEC,REACT,PLSP
      NQ=JSTART
      IF (T.NE.START) GO TO 5
      DO 1  I=1,NOZ
      KOZ=JOZ(I)
      RUN(1,I)=C(KOZ,1)
      NT(I)=1
      TL(I)=START+1.
      OZM(I)=0.
      OZA(I)=0.
    1 CONTINUE
      TLL=TL(1)
      RETURN
    5 DO 60 JJ=1,NOZ
      KOZ=JOZ(JJ)
    6 DO 10 I=1,61
      RR=(TL(JJ)+FLOAT(I-1)-T)/H
      IF (RR.GT.0.) GO TO 15
      IF (TL(JJ)+FLOAT(I-1).GT.STOPP) GO TO 15
      OZ(I,JJ)=C(KOZ,1)
      RH=1.
      DO 10 J=1,NQ
      RH=RH*RR
   10 OZ(I,JJ)=OZ(I,JJ)+RH*C(KOZ,J+1)
      I=61
   15 I=I-1
      TL(JJ)=TL(JJ)+FLOAT(I)
      DO 35 J=1,I
      IF (NT(JJ).GT.60) GO TO 25
      NTT=NT(JJ)
      RUN(NTT+1,JJ)=OZ(J,JJ)
      NT(JJ)=NT(JJ)+1
      IF (NT(JJ).LT.61) GO TO 35
      SIX(JJ)=0.
      S2(JJ)=RUN(60,JJ)
      DO 20 K=1,29
      SIX(JJ)=SIX(JJ)+RUN(2*K+1,JJ)
   20 S2(JJ)=S2(JJ)+RUN(2*K,JJ)
   25 OZA(JJ)=2.*SIX(JJ)+4.*S2(JJ)+RUN(1,JJ)+OZ(J,JJ)
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      SV=SIX(JJ)
      SIX(JJ)=S2(JJ)-RUN(2,JJ)
      S2(JJ)=SV+OZ(J,JJ)
      RUN(61,JJ)=OZ(J,JJ)
      DO 30 K=1,60
   30 RUN(K,JJ)=RUN(K+1,JJ)
      IF (OZA(JJ).GT.OZM(JJ)) OZM(JJ)=OZA(JJ)
      IF (OZA(JJ).EQ.OZM(JJ)) TM(JJ)=TL(JJ)+FLOAT(J-I-31)
   35 CONTINUE
      IF (TL(JJ)-T.LT.0..AND.T.LT.STOPP) GO TO 6
      IF (NGO.NE.0) GO TO 40
      IF (T.GT.360..AND.OZA(JJ).LT.OZM(JJ)) GO TO 45
   40 IF (T.LT.STOPP) GO TO 60
      GO TO 50
   45 TOUT=T
      STOPP=T
   50 OZM(JJ)=OZM(JJ)/180.
      OZA(JJ)=OZA(JJ)/180.
      IF (OZA(JJ).LT.OZM(JJ)) GO TO 60
      IF (T.GT.STOPP.AND.OZM(JJ).GT.0.00001) TM(JJ)=-TM(JJ)
   60 CONTINUE
      TLL=TL(1)
      RETURN
      END
      SUBROUTINE SAVIT (T,C,N)
C
C  SAVE INTERMEDIATE CONCENTRATIONS FOR PLOTTING PURPOSES
C
      COMMON /FRPLOT/ SAVCON(80,5),SAVTIM(80),NT,INOW
      COMMON /SPEC/ NS,HCSPEC(15),CARB(15),RCTY(15),XNF(2),IH(15),
     1INOX(2),FINHC(15),FALHC(15),NHC,OZIN,OZAL,HCIN,HCAL,XNIN,XNAL,
     2NOZ,FENX(2),CR(91),REACT(91),NI,PLSP(5),KOZ(5)
C
      DIMENSION C(80)
      DATA NFRST/1/
C
      IF (NFRST.NE.1.AND.T.EQ.TOLD) RETURN
      IF (NT.LT.0) RETURN
      NFRST=2
      TOLD=T
      IF (NT.GT.80) RETURN
      IF (T.LT.SAVTIM(NT)) RETURN
      SAVTIM(NT)=T
C
      DO 10 II=1,NOZ
      I=KOZ(II)
      SAVCON(NT,II)=C(I)
   10 CONTINUE
      NT=NT+1
      RETURN
      END
      SUBROUTINE SORDER (N,IA,JA,P,Q,MAX,V,L,IER)
      INTEGER IA(1),JA(1),P(1),Q(1),V(1),L(1)
      INTEGER S,SFS,PI,PJ,PK,VI,VJ,VK,QVK,DTHR,DMIN
      IER=0
      DO 5 S=1,MAX
    5 L(S)=S+1
      SFS=1
      L(MAX)=0
      DO 10 K=1,N
      P(K)=K
      Q(K)=K
      V(K)=1
   10 L(K)=0
      SFS=SFS+N
      DO 50 K=1,N
      JMIN=IA(K)
      JMAX=IA(K+1)-1
      IF(JMIN.GT.JMAX+1) GO TO 145
      KDIAG=0
      DO 45 J=JMIN,JMAX
      VJ=JA(J)
      IF (VJ.NE.K) GO TO 15
      KDIAG=1
      GO TO 45
   15 LLK=K
   20 LK=LLK
      LLK=L(LK)
      IF (LLK.EQ.0) GO TO 25
      IF (V(LLK)-VJ) 20,30,25
   25 LLK=SFS
      IF (LLK.EQ.0) GO TO 150
      SFS=L(SFS)
      V(K)=V(K)+1
      V(LLK)=VJ
      L(LLK)=L(LK)
      L(LK)=LLK
   30 LLK=VJ
   35 LK=LLK
      LLK=L(LK)
      IF (LLK.EQ.0) GO TO 40
      IF (V(LLK)-K) 35,45,40
   40 LLK=SFS
      IF (LLK.EQ.0) GO TO 150
      SFS=L(SFS)
      V(VJ)=V(VJ)+1
      V(LLK)=K
      L(LLK)=L(LK)
      L(LK)=LLK
   45 CONTINUE
      IF (KDIAG.EQ.0) GO TO 160
```

```
 50 CONTINUE
    J=0
    DTHR=0
    DMIN=N
    I=0
 55 I=I+1
    IF (I.GT.N) GO TO 140
    JMIN=MAX0(J+1,I)
    IF (JMIN.GT.N) GO TO 70
 60 DO 65 J=JMIN,N
    VI=P(J)
    IF (V(VI).LE.DTHR) GO TO 75
    IF (V(VI).LT.DMIN) DMIN=V(VI)
 65 CONTINUE
 70 DTHR=DMIN
    DMIN=N
    JMIN=I
    GO TO 60
 75 PJ=P(I)
    P(J)=PJ
    Q(PJ)=J
    PI=VI
    P(I)=PI
    Q(PI)=I
    LI=VI
 80 LI=L(LI)
    IF (LI.EQ.0) GO TO 105
    VK=V(LI)
    LLK=VK
    LJ=VI
 85 LJ=L(LJ)
    IF (LJ.EQ.0) GO TO 100
    VJ=V(LJ)
    IF (VJ.EQ.VK) GO TO 85
 90 LK=LLK
    LLK=L(LK)
    IF (LLK.EQ.0) GO TO 95
    IF (V(LLK)-VJ) 90,85,95
 95 LLK=SFS
    IF (LLK.EQ.0) GO TO 155
    SFS=L(SFS)
    V(VK)=V(VK)+1
    V(LLK)=VJ
    L(LLK)=L(LK)
    L(LK)=LLK
    GO TO 85
100 IF (V(VK).GT.V(VI)) GO TO 80
    I=I+1
    QVK=Q(VK)
    PI=P(I)
```

```
      P(QVK)=PI
      Q(PI)=QVK
      P(I)=VK
      Q(VK)=I
      GO TO 80
  105 LI=VI
  110 IF (L(LI).EQ.0) GO TO 135
      LI=L(LI)
      VK=V(LI)
      LLK=VK
      QVK=MIN0(Q(VK),I)
  115 LK=LLK
      LLK=L(LK)
      IF (LLK.EQ.0) GO TO 120
      VJ=V(LLK)
      IF (Q(VJ).GT.QVK) GO TO 115
      V(VK)=V(VK)-1
      L(LK)=L(LLK)
      L(LLK)=SFS
      SFS=LLK
      LLK=LK
      GO TO 115
  120 IF (Q(VK).LE.I) GO TO 130
      IF (V(VK).LE.DTHR) GO TO 125
      IF ((DTHR.LT.V(VK)).AND.(V(VK).LT.DMIN)) DMIN=V(VK)
      GO TO 110
  125 J=MIN0(Q(VK)-1,J)
      DTHR=V(VK)
      GO TO 110
  130 L(LK)=SFS
      SFS=L(VK)
      GO TO 110
  135 L(LI)=SFS
      SFS=L(VI)
      GO TO 55
  140 RETURN
  145 CALL YSMER (3HROW,K,13H OF A IS NULL)
      GO TO 165
  150 CALL YSMER (3HROW,K,16H EXCEEDS STORAGE)
      GO TO 165
  155 CALL YSMER (6HVERTEX,VI,16H EXCEEDS STORAGE)
      GO TO 165
  160 CALL YSMER (6HCOLUMN,K,19H.. DIAGONAL MISSING)
  165 IER=1
      RETURN
      END
      SUBROUTINE YSMER (A,K,A1)                                         AP    1
      INTEGER A,A1(5)                                                   AP    2
      COMMON /INOUT/ INP,LOUT,ITAPE,IALN,IALL,INHH                      AP    3
      WRITE (LOUT,5) A,K,(A1(II),II=1,5)                                AP    4
      RETURN                                                            AP    5
C                                                                       AP    6
C                                                                       AP    7
    5 FORMAT (1X,A4,I6,5A4)                                             AP    8
      END                                                               AP    9-
      FUNCTION CIRC (TI,XI,YI)
      DIMENSION XI(3), YI(3)
      DX=XI(3)-XI(1)
      DY=YI(3)-YI(1)
      X=(XI(2)-XI(1))/DX
      Y=(YI(2)-YI(1))/DY
      T=(TI-XI(1))/DX
      IF (X.EQ.Y) GO TO 10
      B=((X*X+Y*Y)*0.5-X)/(Y-X)
      TT=SQRT(B*B+2.*T*(1.-B)-T*T)
      CX=B+TT
      IF (X.GT.Y) CX=B-TT
      IF (CX.LT.0..OR.CX.GT.1.) GO TO 10
    5 CIRC=CX*DY+YI(1)
      RETURN
   10 CX=T*Y/X
      IF (T.GT.X) CX=(T-X)*(1.-Y)/(1.-X)+Y
      GO TO 5
      END
      SUBROUTINE AXES (X,Y,FIRSTV,FINALV,SCALE,TSTEP,ASTEP,NDEC,ANGLE,IB
     1CD,NCHAR,LABEL)
C
C     *** SAI SUBROUTINE AXES
C         GW LUNDBERG/SAI  DEC 76
C
C         X,Y = COORDINATES IN INCHES OF AXIS LINE STARTING
C               POINT
C         FIRSTV = STARTING VALUE FOR THE AXIS
C         FINALV = ENDING VALUE FOR THE AXIS
C         SCALE = INCHES/UNIT FOR FIRSTV,FINALV,TSTEP,ASTEP
C         TSTEP = STEP SIZE FOR TICS
C         ASTEP = STEP SIZE FOR LABELED TICS
C         NDEC = FORMAT FOR LABELS -- SEE SUBROUTINE NUMBER
C         ANGLE = ANGLE OF AXIS IN DEGRES FROM HORIZONTAL
C         IBCD = THE AXIS TITLE AS ARRAY OR HOLLERITH STRING
C         NCHAR = NUMBER OF CHARACTERS IN TITLE
C               ) 0, TIC MARKS, ANNOTATION AND TITLE PLOTTED ON
C                   CLOCKWISE SIDE OF AXIS LINE
C               ( 0, ON COUNTER CLOCKWISE SIDE
C
C         THIS ROUTINE WAS WRITTEN FOR A MATRIX PLOTTER -- IT DOES
C         NOT OPTIMIZE PEN MOVEMENTS.  THE ROUTINE SHOULD BE MACHINE
C         INDEPENDENT
C
C
C     *** FOLLOWING ARE ADJUSTABLE -- IF LABEL ) 0, ALL TICS ARE
C         LABELED, IF LABEL = 0, THE LAST TIC IS NOT LABELED,
C         IF LABEL ( 0, THE FIRST AND LAST ARE NOT LABELED
C
C     *** DEFINE VARIOUS CHARACTER SIZES
      COMMON /PLTVEC/ HCT(20),OT(20),NH,OHC,HCG,PLTGRD,OXN,XNG,HC1,XN1,T
     1ICSIZ,DIGSIZ,CHRSIZ
      INTEGER IBCD(3)
C
C     *** STEP 1 -- DRAW AXIS AND TIC MARKS
C         ---- -    ---- ---- --- --- -----
C
C     *** MOVE PEN TO START OF AXIS
      X0=X
      Y0=Y
      CALL PLOT (X0,Y0,3)
C
C     *** LOCATE THE OTHER END AND DRAW AXIS
      COSA=COS(ANGLE*0.017453294)
      SINA=SIN(ANGLE*0.017453294)
      AXLEN=(FINALV-FIRSTV)*SCALE
      X1=X0+AXLEN*COSA
      Y1=Y0+AXLEN*SINA
      CALL PLOT (X1,Y1,2)
```

```
C
C     *** ADD THE TIC MARKS ON WRONG SIDE OF AXIS
      POS=FLOAT(ISIGN(1,NCHAR))
      IF (TSTEP.EQ.0.) GO TO 10
      NTIC=(FINALV-FIRSTV)/TSTEP+1.5
      DO 5 J=1,NTIC
C
C         *** MOVE PEN TO START OF TIC
      X1=X0+FLOAT(J-1)*TSTEP*SCALE*COSA
      Y1=Y0+FLOAT(J-1)*TSTEP*SCALE*SINA
      CALL PLOT (X1,Y1,3)
C
C         *** DRAW A TIC NORMAL TO AXIS
      X1=X1+TICSIZ*POS*SINA
      Y1=Y1-TICSIZ*POS*COSA
      CALL PLOT (X1,Y1,2)
    5 CONTINUE
C
C     *** STEP 2 -- SET IN LABELED TICS ON CORRECT SIDE OF AXIS
C         ---- -    --- -- ------- ---- -- ------- ---- -- ----
C
   10 IF (ASTEP.EQ.0.) GO TO 25
      NTIC=(FINALV-FIRSTV)/ASTEP+1.5
      NFRST=1
      NLST=NTIC
      IF (LABEL.LE.0) NLST=NLST-1
      IF (LABEL.LT.0) NFRST=NFRST+1
      DO 15 J=NFRST,NLST
      X1=X0+FLOAT(J-1)*ASTEP*SCALE*COSA
      Y1=Y0+FLOAT(J-1)*ASTEP*SCALE*SINA
      CALL PLOT (X1,Y1,3)
C
      X1=X1-TICSIZ*POS*SINA
      Y1=Y1+TICSIZ*POS*COSA
      CALL PLOT (X1,Y1,2)
   15 CONTINUE
C
C     *** STEP 3 -- ANNOTATE THE TIC MARKS
C         ---- -    -------- --- --- -----
C
C     *** DETERMINE PERPENDICULAR OFFSET TO BOTTOM OF CHARACTER
      OFFSET=TICSIZ+0.03
      IF (POS.NE.1.0) OFFSET=OFFSET+DIGSIZ
C
C     *** CALCULATE LOCATION OF FIRST CHARACTER
      X0=X0-DIGSIZ*COSA
      Y0=Y0-DIGSIZ*SINA
      X0=X0-OFFSET*POS*SINA
      Y0=Y0+OFFSET*POS*COSA
C
```

```
C     *** ANNOTATE THE TIC MARKS
      NFRST=1
      NLAST=NTIC
      IF (LABEL.LE.0) NLAST=NLAST-1
      IF (LABEL.LT.0) NFRST=NFRST+1
      DO 20 J=NFRST,NLAST
C
C         *** GET FLOATING POINT VALUE OF ANNOTATION
      FPN=FIRSTV+FLOAT(J-1)*ASTEP
C
C         *** GET LOCATION AND PLOT FPN
      X1=X0+FLOAT(J-1)*ASTEP*SCALE*COSA
      Y1=Y0+FLOAT(J-1)*ASTEP*SCALE*SINA
      CALL NUMBER (X1,Y1,DIGSIZ,FPN,ANGLE,NDEC)
   20 CONTINUE
C
C     *** STEP 4 -- ADD AXIS TITLE
C         ---- -    --- ---- -----
C
   25 IF (NCHAR.EQ.0) GO TO 30
C     *** SET TITLE OFFSET -- DISTANCE FROM AXIS TO CHARACTERS
      OFFSET=TICSIZ+DIGSIZ+0.10
      IF (NCHAR.LT.0) OFFSET=OFFSET+CHRSIZ
C
C     *** CALCULATE TITLE SIZE
      TSIZ=CHRSIZ*FLOAT(IABS(NCHAR))
C
C     *** CALCULATE OFFSET FROM BEGINNING OF AXIS TO FIRST CHARACTER
      OFF=0.5*(AXLEN-TSIZ)
C
C     *** CALCULATE LOCATION OF FIRST CHARACTER AND PLOT TITLE
      X0=X+OFF*COSA
      Y0=Y+OFF*SINA
      X0=X0-OFFSET*POS*SINA
      Y0=Y0+OFFSET*POS*COSA
      NCCAR=IABS(NCHAR)
      CALL SYMBOL (X0,Y0,CHRSIZ,IBCD,ANGLE,NCCAR)
C
C         FINISHED
   30 RETURN
      END
      SUBROUTINE CURVE (XARRAY,YARRAY,NPTS,INC,KALCMP,LINTYP,INTEQ,SIGMA
     1)
C
C     *** PURPOSE -- PLOTS A SMOOTH CURVE THROUGH THE DATA VALUES FROM T
C         GW LUNDBERG,SAI   JULY  77
C
C          MODIFIED BY H HOGO AUG 1977
C
C         XARRAY  ARRAY CONTAINING X VALUES
C         YARRAY  ARRAY CONTIANING Y VALUES
C         NPTS    NUMBER OF DATA POINTS IN THE ARRAYS ACTUALLY USED
C                 ) 0  SCALING AT TOP OF ARRAYS
C         INC     EVERY INC POINT WILL BE USED
C         LINTYP  PLOT SPECIAL SYMBOL EVERY LINTYP POINT
C                 ) 0  CONNECTED SYMBOL PLOT
C                 = 0  LINE PLOT
C                 ( 0  UNCONNECTED SYMBOL PLOT
C         INTEQ   INTEGER EQUIVALENT OF SPECIAL SYMBOL
C         THIS ROUTINE CALLS  SYMBOL, PLOT, KURV1 AND KURV2
C
      COMMON /VVLB1/ FCTR,DIST,CHRSZ,NCHR,OZLBL
      COMMON /HOUR/ OZR(5),NGG,TM,DUM(5)
      COMMON /NEED/ HC,XN,NL,NR,R(20),OZP(20),OZN(8,20),RHO(8,20),MR,OC(
     14),OS(2),HCS,XNS,LS,HCLL(8),XNLL(8)
      COMMON /INOUT/ INP,LOUT,ITAPE,IALN,IALL,INHH
      DIMENSION XARRAY(1), YARRAY(1), XI(50), YI(50), XP(50), YP(50), TE
     1MP(50)
C
      DATA NSLOPE/0/,SLOPE1,SLOPEN/0.,0./
C
C
C     *** LOCATE SCALING (FIRSTV AND DELTAV) FOR EACH ARRAY
C         ------ ------- ------- --- ------- --- ---- -----
C
C
C     *** SCALING IN TOP OF ARRAYS -- CALCOMP STANDARD
      N=NPTS*INC+1
      FIRSTX=XARRAY(N)
      FIRSTY=YARRAY(N)
      N=N+INC
      DELTAX=XARRAY(N)
      DELTAY=YARRAY(N)
C
      NUM=IABS(NPTS)
      IF (KALCMP.LE.0) GO TO 10
C
C     *** CHECK IF SYMBOL PLOT WANTED -- LINTYP () 0
      IF (LINTYP.EQ.0) GO TO 10
C
C     *** CENTERED SYMBOL PLOT
```

```
C         -------- ------ ----
C
C     *** SCALE FIRST DATA POINT AND PLOT CENTERED SYMBOL
      X=(XARRAY(1)-FIRSTX)/DELTAX
      Y=(YARRAY(1)-FIRSTY)/DELTAY
      CALL SYMBOL (X,Y,0.1,INTEQ,0.,-1)
C
C     *** PLOT REMAINING SYMBOLS AT INCREMENTS OF MARK
      MARK=IABS(LINTYP)
      N=1
C
      DO 5 J=2,NUM
      N=N+INC
      IF (MOD(N,MARK).NE.0) GO TO 5
      X=(XARRAY(N)-FIRSTX)/DELTAX
      Y=(YARRAY(N)-FIRSTY)/DELTAY
      CALL SYMBOL (X,Y,0.1,INTEQ,0.,-1)
    5 CONTINUE
C
C     *** IF THE SYMBOLS ARE NOT TO BE CONNECTED, RETURN
      IF (LINTYP.LT.0) GO TO 30
C
C     *** LINE PLOT (OR CONNECT SYMBOLS)
C         ---- ---- -- ------ --------
C
C     *** SCALE FIRST DATA POINT AND MOVE PEN THERE
   10 XI(1)=(XARRAY(1)-FIRSTX)/DELTAX
      YI(1)=(YARRAY(1)-FIRSTY)/DELTAY
C
C
C     *** SCALE THE REMAINING POINTS
      N=1
      DO 15 J=2,NUM
      N=N+INC
      XI(J)=(XARRAY(N)-FIRSTX)/DELTAX
      YI(J)=(YARRAY(N)-FIRSTY)/DELTAY
   15 CONTINUE
C
      NSLP=NSLOPE
C
C     *** CHECK IF PERIODIC
      IF (ABS(XI(NUM)-XI(1)).LT.0.01.AND.ABS(YI(NUM)-YI(1)).LT.0.01)
     1  NSLP=-1
C
C     *** SET UP SPLINE INTERPOLATION
      NSLP=1
      SLOPE1=57.29578*ATAN((YI(1)-YI(2))/(XI(1)-XI(2)))
      IF (SLOPE1.GT.0.) SLOPE1=SLOPE1-180.
      SLOPE1=AMIN1(SLOPE1,-90.)
      SLOPEN=28.64789*ATAN((YI(N)-YI(N-1))/(XI(N)-XI(N-1)))
      CALL KURV1 (NUM,XI,YI,NSLP,SLOPE1,SLOPEN,XP,YP,TEMP,S,SIGMA)
      CALL KURV2 (0.,X,Y,NUM,XI,YI,XP,YP,S,SIGMA)
      X=AMAX1(0.,X)
      Y=AMAX1(0.,Y)
      USX=X*DELTAX+FIRSTX
      USY=Y*DELTAY+FIRSTY
      TM=1.
      CALL ISOPLT (USX,USY,2)
      WRITE (IALN,1000) USX,USY,OZLBL
 1000 FORMAT (1X,3E13.4)
      TM=2.
C
C     *** LINE SEGMENTS WILL BE A TENTH INCH LONG -- S IS THE ARCLENGTH
      NP=10.*S+1.0
      CONST=1./FLOAT(NP)
      DIST=S
      IF (KALCMP.LE.0) GO TO 20
      IF (USX.GT.HC.OR.USY.GT.XN) GO TO 20
      CALL VVLBLF (XI(1),YI(1),1)
C
C     *** MAP AND PLOT SEGMENTS
   20 DO 25 J=1,NP
      T=-FLOAT(J)*CONST
      CALL KURV2 (T,X,Y,NUM,XI,YI,XP,YP,S,SIGMA)
      X=AMAX1(0.,X)
      Y=AMAX1(0.,Y)
      USX=X*DELTAX+FIRSTX
      USY=Y*DELTAY+FIRSTY
      CALL ISOPLT (USX,USY,2)
      WRITE (IALN,1000) USX,USY,OZLBL
      IF (KALCMP.LE.0) GO TO 25
      IF (USX.GT.HC.OR.USY.GT.XN) GO TO 25
      CALL VVLBLF (X,Y,2)
   25 CONTINUE
      IF (KALCMP.LE.0) GO TO 30
      IF (USX.GT.HC.OR.USY.GT.XN) GO TO 30
      CALL VVLBLF (0.,0.,3)
C
   30 RETURN
C
      END
      SUBROUTINE FRAME (X,Y,FRSTX,FINX,SIZX,TICX,STEPX,NDECX,FRSTY,FINY,
     1SIZY,TICY,STEPY,NDECY,LBLBOT,NB,LBLLFT,NL,LBLTOP,NT,LBLRGT,NR)
C
C     *** PURPOSE -- PREPARES AN ANNOTATED FOUR SIDED FRAME
C         WITH LOWER LEFT CORNER AT (X,Y)
C             GWL/SAI  MARCH  77
C
C         SEE SUBROUTINE AXES FOR DESCRIPTION OF ARGUMENTS
C
      COMMON /PLTVEC/ HCT(20),OT(20),NH,OHC,HCG,PLTGRD,OXN,XNG,HCC,XNC,T
     1ICZ,DIGZ,CHRZ
      INTEGER LBLBOT(3),LBLTOP(3),LBLLFT(3),LBLRGT(3)
C
C     *** CALCULATE THE AXES LENGTHS
      XLEN=(FINX-FRSTX)*SIZX
      YLEN=(FINY-FRSTY)*SIZY
C
C     *** PLACE GRIDDED LINES ON PLOT
C
      IF (ABS(PLTGRD).EQ.0.) GO TO 40
      IF (PLTGRD.LT.0.) GO TO 25
      CALL NEWPEN (2)
      STINC=(STEPY/10.)*SIZY
      ILP=FINY/STEPY+.005
      ILP=ILP*10-1
      STVAL=STINC
      J=1
      DO 10 I=1,ILP
      IF (J.EQ.2) GO TO 5
      CALL PLOT (X,STVAL,3)
      CALL PLOT (XLEN,STVAL,2)
      STVAL=STVAL+STINC
      J=2
      GO TO 10
    5 CALL PLOT (XLEN,STVAL,3)
      CALL PLOT (X,STVAL,2)
      STVAL=STVAL+STINC
      J=1
   10 CONTINUE
      STINC=(STEPX/10.)*SIZX
      ILP=FINX/STEPX+.005
      ILP=ILP*10-1
      STVAL=STINC
      J=1
      DO 20 I=1,ILP
      IF (J.EQ.2) GO TO 15
      CALL PLOT (STVAL,Y,3)
      CALL PLOT (STVAL,YLEN,2)
      STVAL=STVAL+STINC
      J=2
      GO TO 20
   15 CALL PLOT (STVAL,YLEN,3)
      CALL PLOT (STVAL,Y,2)
      STVAL=STVAL+STINC
      J=1
   20 CONTINUE
      CALL NEWPEN (1)
      GO TO 40
C
C  PLOT GRIDDED LINES WITH MATRIX PLOTTER
C
   25 IPLT=IFIX(PLTGRD)
      CALL NEWPEN (IPLT)
      STINC=(STEPY/10.)*SIZY
      ILP=IFIX(FINY/STEPY+0.005)*10-1
      STVAL=STINC
      DO 30 I=1,ILP
      IF (MOD(I,10).EQ.0) CALL NEWPEN (IPLT+1)
      CALL PLOT (X+0.01,STVAL,3)
      CALL PLOT (XLEN,STVAL,2)
      IF (MOD(I,10).EQ.0) CALL NEWPEN (IPLT)
      STVAL=STVAL+STINC
   30 CONTINUE
      STINC=(STEPX/10.)*SIZX
      ILP=IFIX(FINX/STEPX+0.005)*10-1
      STVAL=STINC
      DO 35 I=1,ILP
      IF (MOD(I,10).EQ.0) CALL NEWPEN (IPLT+1)
      CALL PLOT (STVAL,Y-0.02,3)
      CALL PLOT (STVAL,Y,3)
      CALL PLOT (STVAL,YLEN,2)
      IF (MOD(I,10).EQ.0) CALL NEWPEN (IPLT)
      STVAL=STVAL+STINC
   35 CONTINUE
      CALL NEWPEN (0)
   40 CONTINUE
C
C     *** PLOT THE FOUR SIDES WITH ANNOTATIONS
      CALL AXES (X,Y,FRSTX,FINX,SIZX,TICX,STEPX,NDECX,0.,LBLBOT,-NB,1)
      CALL AXES (X,Y,FRSTY,FINY,SIZY,TICY,STEPY,NDECY,90.,LBLLFT,NL,1)
      CALL AXES (X,Y+YLEN,FRSTX,FINX,SIZX,TICX,STEPX,NDECX,0.,LBLTOP,NT,
     1-1)
      CALL AXES (X+XLEN,Y,FRSTY,FINY,SIZY,TICY,STEPY,NDECY,90.,LBLRGT,-N
     1R,-1)
C
      RETURN
      END
      SUBROUTINE SPLOT
      COMMON /TITL/ ITTL(36)
      COMMON /INOUT/ IN,IOUT,ITAPE,IALN,IALL,INHH
      COMMON /CALC/ NR,KR(200,12),A(200),S(200),R(200),ITYPE(200),IA(90)
     1,JA(1500),DILUT,TEMP,ERR,START,STOPP,SPECIS(91),TPRNT,TSTEP,ZENI
      COMMON /SUNLIT/ Z(10),RTCON(10),
     1LAM1,INC,SLA,SLO,TZ,IY,IM,ID,ISTRT,ISTOP,IINC,IEND,SPECIE,MAXZ,ITI
     2ME(24),XZ(24),KKK(24),JSTRT,JSTOP,PSPEC,MNLM,MXLM,MAXL,MAXJ
      COMMON /SCRAT/ JGRID(101,50),NGRID(101,2)
      COMMON /SPEC/ NS,HCSPEC(15),CARB(15),RCTY(15),XNF(2),IH(15),
     1INOX(2),FINHC(15),FALHC(15),NHC,OZIN,OZAL,HCIN,HCAL,XNIN,XNAL,
     2NOZ,FENX(2),C(91),REACT(91),NI,PLSP(5),KOZ(5)
      COMMON /HOUR/ OZM(5),NGO,TM,DUMMM(5)
      COMMON /FRPLOT/ SAVCON(80,5),SAVTIM(80),NT1,INOW
      COMMON /PLTND/ JBAR,JSYMB,CVERT(9),TVERT(52,2)
      COMMON /NEED1/ JBLANK,MBLANK,IIHC,IINX,IICO,IINO2,IINO,IIO3,
     1IIH2O,IBZA,JPLUS
      DIMENSION TPRINT(11),TV1(10)
      DATA MAXHC/101/,MAXNOX/50/,TGRID/100./,CGRID/50./
C
      NT=NT1-1
      TCI=FLOAT(JSTRT)
      DO 1000 L=1,NOZ
      IF (OZM(L).LE.0.) GO TO 1000
      DO 5 J=1,50
      IF (J.LE.2) NGRID(1,J)=JBAR
      IF (J.LE.2) NGRID(101,J)=JBAR
      JGRID(1,J)=JBAR
      JGRID(101,J)=JBAR
    5 CONTINUE
      DO 25 J=1,50,5
      JGRID(1,J)=JPLUS
      JGRID(101,J)=JPLUS
   25 CONTINUE
C
C SET NORMALIZATION FACTORS AND VERTICAL LABELS
C
      CLOW=0.
      TLOW=0.
      CH=OZM(L)*1.1
      CH1=ALOG10(CH)
      IAMEG=IFIX(CH1)
      IF (CH1.LT.0.) IAMEG=IAMEG-1
      CHIGH=CH/(10.**IAMEG)
      REM=CHIGH-FLOAT(IFIX(CHIGH))
      CHIGH=CH+(1.-REM)*(10.**IAMEG)
      CSPAN=CGRID/CHIGH
      DO 30 I=1,10
      M=11-I
      TV1(I)=(FLOAT(M)*.1)*CHIGH
   30 CONTINUE
C
C SET HORIZONTAL LABELS
C
   35 THIGH=STOPP
   40 TSPAN=TGRID/THIGH
      DO 45 J=1,11
      TPRINT(J)=(FLOAT(J-1)/10.)*THIGH+.5
      TPRINT(J)=CLOCK(TCI,IFIX(TPRINT(J)))
   45 CONTINUE
C
C CLEAR GRID
C
      MAXHC1=MAXHC-1
      DO 50 K=1,MAXNOX
      DO 50 J=2,MAXHC1
      JGRID(J,K)=JBLANK
      IF (K.LE.2) NGRID(J,K)=JBLANK
   50 CONTINUE
C
      DO 60 J=1,NT
      KHC=IFIX((SAVTIM(J)-TLOW)*TSPAN+1.5)
      KNOX=IFIX((SAVCON(J,L)-CLOW)*CSPAN-0.5)
      KNOX=MAXNOX-KNOX
      IF (KNOX.LT.1) GO TO 60
      IF (KNOX.GT.MAXNOX) GO TO 60
      IF (KHC.LT.1) GO TO 60
      IF (KHC.GT.MAXHC1) GO TO 60
      IF (KHC.LT.2) GO TO 60
      JGRID(KHC,KNOX)=JSYMB
   60 CONTINUE
C
      WRITE (IOUT,120) TVERT(1,1),TV1(1)
      DO 115 K=2,MAXNOX
      M=MOD((K-1),5)
      I=(K-1)/5+1
      IF (M.EQ.0) WRITE (IOUT,130) TVERT(K,1),TV1(I),(JGRID(J,K),J=1,MAX
     1HC)
      IF (M.NE.0) WRITE (IOUT,135) TVERT(K,1),(JGRID(J,K),J=1,MAXHC)
  115 CONTINUE
      WRITE (IOUT,140) CLOW
      WRITE (IOUT,155) TPRINT
      WRITE (IOUT,150) (ITTL(I),I=1,36)
      WRITE (IOUT,160) PLSP(L)
 1000 CONTINUE
C
      RETURN
C
C  FORMAT STATEMENTS
C
```

```
120 FORMAT (1H1////9X,A4,F5.3,1H+,10(10H---------+))                   AU  101
125 FORMAT (1H1//////18X,1H+,10(10H---------+)/18X,101A1/18X,101A1)    AU  102
130 FORMAT (9X,A4,F5.3,101A1)                                          AU  103
135 FORMAT (9X,A4,5X,101A1)                                            AU  104
140 FORMAT (13X,F5.3,1H+,10(10H---------+))                            AU  105
150 FORMAT (46X,36A2)                                                  AU  106
155 FORMAT (F21.0,10F10.0/63X,14H  TIME (LDT)  //)                     AU  107
160 FORMAT (1H0/45X,A4,36H CONCENTRATION AS A FUNCTION OF TIME)        AU  108
    END                                                                AU  109-
```

```
      SUBROUTINE ISOPLT (SAVHC,SAVNOX,IENTRY)                           AV
      COMMON /NEED/ HC,XN,NL,NRTO,RTO(20),OZZ(20),OZN(8,20),RHO(8,20),MRAV
     1,OC(4),OS(2),HCS,XNS,LS,HCLL(8),XNLL(8)                           AV
      COMMON /TITL/ ITTL(36)                                            AV
      COMMON /INOUT/ IN,IOUT,ITAPE,IALN,IALL,INHH                       AV
      COMMON /CALC/ NR,KR(200,12),A(200),S(200),R(200),ITYPE(200),IA(90)AV
     1,JA(1500),DILUT,TEMP,ERR,START,STOPP,SPECIS(91),TPRNT,TSTEP,ZENI  AV
      COMMON /SCRAT2/ JGRID(101,42),JDUM(1010)                          AV
      COMMON /CNTRL/ SIG,SIGMA,INFO,NPTO,TSRT,DTIM,Z1,Z2,DCON,EHC,EXN,FIL AV
     1ST,TLST                                                           AV
      COMMON /SPEC/ NS,HCSPEC(15),CARB(15),RCTY(15),XNF(2),IH(15),      AV
     1INOX(2),FINHC(15),FALHC(15),NHC,OZIN,OZAL,HCIN,HCAL,XNIN,XNAL,    AV
     2NOZ,FENX(2),C(91),REACT(91),NI,PLSP(5),KOZ(5)                     AV
      COMMON /GEAR6/ DUM1(880),XZP(20),DUM2(326),NGRID(101,2),DUM3(572) AV
      COMMON /HOUR/ OZM(5),NGO,TM,DUMMM(5)                              AV
      COMMON /SCRAT3/ OZP(20)                                           AV
      DIMENSION TVERT(52,2), TPRINT(11), NLINE(3)                       AV
      DIMENSION CVERT(9), TV(7), SAVDAT(101), TV1(7)                    AV
      INTEGER JBLANK, CVERT, TV, TVERT                                  AV
      DATA JBLANK/4H    /,MAXHC/101/,MAXNOX/42/,TGRID/100./,            AV
     1CGRID/42./,JPLUS/1H+/,JBAR/1HI/,JSYMB/1H+/,JBL/1H /,JO/1HO/       AV
      DATA CVERT/4H O  ,4H Z  ,4H O  ,4H N  ,4H E  ,4H    ,4H P  ,4H P  AV
     1,4H M  /                                                          AV
      DATA TV/4H N  ,4H O  ,4H X  ,4H    ,4H P  ,4H P  ,4H M  /         AV
      DATA TVERT/104*4H    /                                            AV
C                                                                       AV
C     EMULATE MULTIPLE ENTRY POINTS WITH COMPUTED GO TO                 AV
      GO TO (1000,2000,3000),IENTRY                                     AV
      STOP                                                              AV
 1000 CONTINUE                                                          AV
      NR1=1                                                             AV
      DO 5 J=1,42                                                       AV
      IF (J.LE.2) NGRID(1,J)=JBAR                                       AV
      IF (J.LE.2) NGRID(101,J)=JBAR                                     AV
      JGRID(1,J)=JBAR                                                   AV
      JGRID(101,J)=JBAR                                                 AV
    5 CONTINUE                                                          AV
      DO 15 I=1,52                                                      AV
      TVERT(I,1)=JBLANK                                                 AV
      IF (NPTO.EQ.0) GO TO 10                                           AV
      IF (I.LT.18.OR.I.GT.26) GO TO 15                                  AV
      K=I-17                                                            AV
      TVERT(I,1)=CVERT(K)                                               AV
      GO TO 15                                                          AV
   10 IF (I.LT.17.OR.I.GT.23) GO TO 15                                  AV
      K=I-16                                                            AV
      TVERT(I,1)=TV(K)                                                  AV
   15 CONTINUE                                                          AV
      DO 20 I=1,101                                                     AV
   20 SAVDAT(I)=0.                                                      AV
```

```
      DO 25 J=1,42,3
      JGRID(1,J)=JPLUS
      JGRID(101,J)=JPLUS
   25 CONTINUE
C
C SET NORMALIZATION FACTORS AND VERTICAL LABELS
C
      CLOW=0.
      TLOW=0.
      IF (NPTO.NE.0) GO TO 35
      CHIGH=XN
      CSPAN=CGRID/CHIGH
      THIGH=HC
      DO 30 I=1,7
      M=8-I
      TV1(I)=(FLOAT(M)/7.)*CHIGH
   30 CONTINUE
      GO TO 40
C
C SET HORIZONTAL LABELS
C
   35 THIGH=STOPP
   40 TSPAN=TGRID/THIGH
      DO 45 J=1,11
      TPRINT(J)=(FLOAT(J-1)/10.)*THIGH
   45 CONTINUE
C
C CLEAR GRID
C
      MAXHC1=MAXHC-1
      DO 50 K=1,MAXNOX
      DO 50 J=2,MAXHC1
      JGRID(J,K)=JBLANK
      IF (K.LE.2) NGRID(J,K)=JBLANK
   50 CONTINUE
      RETURN
C
C ENTRY FOR SAVING INTERPOLATED POINTS
C
C     ENTRY SAVLIN
 2000 CONTINUE
      KHC=IFIX((SAVHC-TLOW)*TSPAN+1.5)
      IF (NPTO.NE.0) GO TO 55
      KNOX=IFIX((SAVNOX-CLOW)*CSPAN-0.5)
      KNOX=MAXNOX-KNOX
      IF (KNOX.LT.1) GO TO 60
      IF (KNOX.GT.MAXNOX) GO TO 60
   55 IF (KHC.LT.1) GO TO 60
      IF (KHC.GT.MAXHC1) GO TO 60
      IF (NPTO.EQ.0) JGRID(KHC,KNOX)=JSYMB
      IF (NPTO.NE.0) GO TO 56
      IF (TM.EQ.1..AND.NPTO.EQ.0) DUM3(NR1)=FLOAT(KHC)
      IF (TM.EQ.1.) NR1=NR1+1
      IF (KHC.LT.2) GO TO 60
   56 CONTINUE
      IF (NPTO.NE.0) SAVDAT(KHC)=SAVNOX
   60 RETURN
C
C ENTRY FOR PLOTTING GRID
C
C     ENTRY LINPRT
 3000 CONTINUE
      IF (NPTO.NE.0) GO TO 95
      NPL=IFIX(HCS+0.1)
      NLL=IFIX(XNS+0.5)
      KOUNT=0
      IF (NLL.EQ.0) GO TO 80
      NJ=1
   65 NJ=NJ+1
      J=MAXNOX-NJ
      IF (JGRID(3,J).EQ.JBLANK) GO TO 65
      KOUNT=KOUNT+1
      IF (KOUNT.GT.NLL) GO TO 75
      IF (NJ.GT.MAXNOX-1) GO TO 75
      NVAR=IFIX(OZP(KOUNT)*100.+0.5)
      CALL CONVT (NVAR,NLINE,3)
      DO 70 II=1,3
         I12=II+2
   70 IF (NLINE(II).NE.JBL) JGRID(I12,J)=NLINE(II)
      NJ=NJ+1
      GO TO 65
   75 KOUNT=KOUNT-1
   80 KOUNT=KOUNT+1
      NR1=NR1-1
      DO 90 I=KOUNT,NR1
      NVAR=IFIX(OZP(I)*100.+0.5)
      CALL CONVT (NVAR,NLINE,3)
      KHC=IFIX(DUM3(I)+0.1)
      DO 85 II=2,3
   85 IF (NLINE(II).NE.JBL) NGRID(KHC,II-1)=NLINE(II)
   90 CONTINUE
      GO TO 110
   95 CHIGH=OZM(1)+(0.2*OZM(1))
      IF (OZM(1).EQ.0.0) RETURN
      CSPAN=CGRID/CHIGH
      DO 100 I=1,7
      M=8-I
      TV1(I)=(FLOAT(M)/7.)*CHIGH
  100 CONTINUE
      DO 105 I=2,100
      IF (SAVDAT(I).EQ.0.) GO TO 105
      KNOX=IFIX(SAVDAT(I)*CSPAN-0.5)
      KNOX=MAXNOX-KNOX
      IF (KNOX.LT.1) GO TO 105
      IF (KNOX.GT.MAXNOX) GO TO 105
      JGRID(I,KNOX)=JO
  105 CONTINUE
  110 IF (NPTO.EQ.0) WRITE (IOUT,125) ((NGRID(I,J),I=1,101),J=1,2)
      IF (NPTO.NE.0) WRITE (IOUT,120) TVERT(1,1),TV1(1)
      IF (NPTO.EQ.0) KFRST=1
      IF (NPTO.NE.0) KFRST=2
      DO 115 K=KFRST,MAXNOX
      L=MOD((K-1),6)
      I=(K-1)/6+1
      IF (L.EQ.0) WRITE (IOUT,130) TVERT(K,1),TV1(I),(JGRID(J,K),J=1,MAX
     1HC)
      IF (L.NE.0) WRITE (IOUT,135) TVERT(K,1),(JGRID(J,K),J=1,MAXHC)
  115 CONTINUE
      WRITE (IOUT,140) CLOW
      IF (NPTO.EQ.0) WRITE (IOUT,145) TPRINT
      IF (NPTO.NE.0) WRITE (IOUT,155) TPRINT
      WRITE (IOUT,150) (ITTL(I),I=1,36)
      IF (NPTO.EQ.0) WRITE (IOUT,160) PLSP(1),(OZP(I),I=1,NPL)
99999 RETURN
C
C
  120 FORMAT (1H1/////////9X,A4,F5.3,1H+,10(10H---------+))
  125 FORMAT (1H1//////18X,1H+,10(10H---------+)/18X,101A1/18X,101A1)
  130 FORMAT (9X,A4,F5.3,101A1)
  135 FORMAT (9X,A4,5X,101A1)
  140 FORMAT (13X,F5.3,1H+,10(10H---------+))
  145 FORMAT (F21.3,10F10.2/64X,11HNMOC (PPMC)//)
  150 FORMAT (46X,36A2)
  155 FORMAT (F21.1,10F10.1/63X,14HTIME (MINUTES)//)
  160 FORMAT (1H0/20X,4HTHE ,A4,12H LINES ARE  ,10F8.5/40X,10F8.5)
      END
      SUBROUTINE KURV1 (NPTS,X,Y,NSLOPE,SLOPE1,SLOPEN,XP,YP,TEMP,S,SIGMA
     1)
C
C    THIS SUBROUTINE DETERMINES THE PARAMETERS NECESSARY TO
C    COMPUTE AN SPLINE UNDER TENSION PASSING THROUGH A SEQUENCE
C    OF PAIRS (X(1),Y(1),....,X(N),Y(N)) IN THE PLANE, THE
C    SLOPES AT THE TWO ENDS OF THE CURVE MAY BE SPECIFIED OR
C    OMITTED, FOR ACTUAL COMPUTATION OF POINTS ON THE CURVE IT
C    IS NECESSARY TO CALL THE SUBROUTINE KURV2.
C
C    ON INPUT --
C    NPTS = THE NUMBER OF POINTS TO BE INTERPOLATED (N.GE.2),
C    X = AN ARRAY CONTAINING THE N X-COORDINATES OF THE
C        POINTS,
C    Y = AN ARRAY CONTAIING THE N Y-COODINATES OF THE
C        POINTS,
C    NSLOPE = A FLAG FOR ENDPOINT SLOPES.  IF • 0, THIS IS A CLOSED
C        LOOP AND NO SLOPES ARE GIVEN.  IF = 0, THIS IS AN OPEN CURVE
C        AND NO SLOPES ARE GIVEN.  IF ) 0, BOTH ENDPOINT SLOPES ARE
C        GIVEN
C    SLOPE1,SLOPEN = THE DESIRED VALUES FOR THE SLOPE
C        OF THE CURVE AT (X(1),Y(1)) AND (X(N),Y(N)), RESPEC-
C        TIVELY.  THESE QUANTITIES ARE IN DEGREES AND MEASURED
C        COUNTER CLOCKWISE FROM THE POSITIVE X-AXIS.  THE POSITIVE
C        SENSE OF THE CURVE IS ASSUMED TO BE THAT MOVING FROM THE
C        POINT 1 TO POINT N.
C    XP,YP = ARRAYS OF LENGTH AT LEAST N,
C    TEMP = AN ARRAY OF LENGTH AT LEAST N WHICH IS USED FOR
C        SCRATCH STORAGE,
C    SIGMA = THE TENSION FACTOR.  THIS IS NON-ZERO AND
C        INDICATES THE CURVINESS DESIRED.  IF SIGMA IS VERY
C        LARGE (E.G. 50.) THE RESULTING CURVE IS VERY NEARLY A
C        POLYGONAL LINE.  A STANDARD VALUE FOR SIGMA IS 1.
C
C    ON OUTPUT -
C    N,X,Y,SLOPE1,SLOPEN, AND SIGMA ARE UNALTERED,
C    XP,YP CONTAIN INFORMATION ABOUT THE CURVATURE OF THE
C        CURVE AT THE GIVEN NODE,
C    S = THE POLYGONAL ARCLENGTH OF THE CURVE.
C
C     *** AK CLINE, COMM. ACM 17,4(APR.1974), 221
C         MODIFIED BY GW LUNDBERG/SAI  MAY ¶77
C
      DIMENSION X(NPTS), Y(NPTS), XP(NPTS), YP(NPTS), TEMP(NPTS)
C
      DATA EXPMAX/87.4/
      TEMAX=-9999.
      DEGRAD=3.1415926/180.
      N=NPTS
      SLP1=SLOPE1
      SLPN=SLOPEN
      NM1=N-1
      NP1=N+1
      DELX1=X(2)-X(1)
      DELY1=Y(2)-Y(1)
      DELS1=SQRT(DELX1*DELX1+DELY1*DELY1)
      DX1=DELX1/DELS1
      DY1=DELY1/DELS1
C
C       *** DETERMINE SLOPES IF NECESSARY
      IF (NSLOPE) 55,45,5
    5 SLPP1=SLP1*DEGRAD
      SLPPN=SLPN*DEGRAD
C
C     *** SET UP RIGHT HAND SIDES OF TRIDIAGONAL LINEAR SYSTEM FOR
C         XP AND YP
   10 XP(1)=DX1-COS(SLPP1)
      YP(1)=DY1-SIN(SLPP1)
      TEMP(1)=DELS1
      S=DELS1
      IF (N.EQ.2) GO TO 20
      DO 15 I=2,NM1
      DELX2=X(I+1)-X(I)
      DELY2=Y(I+1)-Y(I)
      DELS2=SQRT(DELX2*DELX2+DELY2*DELY2)
      DX2=DELX2/DELS2
      DY2=DELY2/DELS2
      XP(I)=DX2-DX1
      YP(I)=DY2-DY1
      TEMP(I)=DELS2
      TEMAX=AMAX1(TEMAX,TEMP(I))
      DELX1=DELX2
      DELY1=DELY2
      DELS1=DELS2
      DX1=DX2
      DY1=DY2
C
C     *** ACCUMULATE POLYGONAL ARCLENGTH
      S=S+DELS1
   15 CONTINUE
   20 XP(N)=COS(SLPPN)-DX1
      YP(N)=SIN(SLPPN)-DY1
C
C     *** DENORMALIZE TENSION FACTOR
      SIGMAP=ABS(SIGMA)*FLOAT(N-1)/S
      DELT1=SIGMAP*TEMAX
      IF (DELT1.LT.EXPMAX) GO TO 25
      SIGMAP=0.9*EXPMAX/TEMAX
      SGN=1.0
      IF (SIGMA.LT.0.) SGN=-1.0
      SIGMA=SIGMAP*SGN*S/FLOAT(N-1)
   25 CONTINUE
C
C     *** PERFORM FORWARD ELIMINATION ON TRIDIAGONAL SYSTEM
      DELS=SIGMAP*TEMP(1)
      EXPS=EXP(DELS)
      SINHS=.5*(EXPS-1./EXPS)
      SINHIN=1./(TEMP(1)*SINHS)
      DIAG1=SINHIN*(DELS*.5*(EXPS+1./EXPS)-SINHS)
      DIAGIN=1./DIAG1
      XP(1)=DIAGIN*XP(1)
      YP(1)=DIAGIN*YP(1)
      SPDIAG=SINHIN*(SINHS-DELS)
      TEMP(1)=DIAGIN*SPDIAG
      IF (N.EQ.2) GO TO 35
      DO 30 I=2,NM1
      DELS=SIGMAP*TEMP(I)
      EXPS=EXP(DELS)
      SINHS=.5*(EXPS-1./EXPS)
      SINHIN=1./(TEMP(I)*SINHS)
      DIAG2=SINHIN*(DELS*(.5*(EXPS+1./EXPS))-SINHS)
      DIAGIN=1./(DIAG1+DIAG2-SPDIAG*TEMP(I-1))
      XP(I)=DIAGIN*(XP(I)-SPDIAG*XP(I-1))
      YP(I)=DIAGIN*(YP(I)-SPDIAG*YP(I-1))
      SPDIAG=SINHIN*(SINHS-DELS)
      TEMP(I)=DIAGIN*SPDIAG
      DIAG1=DIAG2
   30 CONTINUE
   35 DIAGIN=1./(DIAG1-SPDIAG*TEMP(NM1))
      XP(N)=DIAGIN*(XP(N)-SPDIAG*XP(NM1))
      YP(N)=DIAGIN*(YP(N)-SPDIAG*YP(NM1))
C
C     *** PERFORM BACK SUBSTITUTION
      DO 40 I=2,N
      IBAK=NP1-I
      XP(IBAK)=XP(IBAK)-TEMP(IBAK)*XP(IBAK+1)
      YP(IBAK)=YP(IBAK)-TEMP(IBAK)*XP(IBAK+1)
   40 CONTINUE
      RETURN
   45 IF (N.EQ.2) GO TO 50
C
C     *** IF NO SLOPES ARE GIVEN, USE SECOND ORDER INTERPOLATION ON
C         INPUT DATA FOR SLOPES AT ENDPOINTS
      DELS2=SQRT((X(3)-X(2))**2+(Y(3)-Y(2))**2)
      DELS12=DELS1+DELS2
      C1=-(DELS12+DELS1)/DELS12/DELS1
      C2=DELS12/DELS1/DELS2
      C3=-DELS1/DELS12/DELS2
      SX=C1*X(1)+C2*X(2)+C3*X(3)
      SY=C1*Y(1)+C2*Y(2)+C3*Y(3)
      SLPP1=ATAN2(SY,SX)
      DELNM1=SQRT((X(N-2)-X(NM1))**2+(Y(N-2)-Y(NM1))**2)
      DELN=SQRT((X(NM1)-X(N))**2+(Y(NM1)-Y(N))**2)
      DELNN=DELNM1+DELN
      C1=(DELNN+DELN)/DELNN/DELN
      C2=-DELNN/DELN/DELNM1
      C3=DELN/DELNN/DELNM1
      SX=C3*X(N-2)+C2*X(NM1)+C1*X(N)
      SY=C3*Y(N-2)+C2*Y(NM1)+C1*Y(N)
      SLPPN=ATAN2(SY,SX)
      GO TO 10
C
C     *** IF ONLY TWO POINTS AND NO SLOPES ARE GIVEN, USE STRAIGHT
C         LINE SEGMENT FOR CURVE
   50 XP(1)=0.
      XP(2)=0.
      YP(1)=0.
      YP(2)=0.
      RETURN
C
C     *** CLOSED LOOP -- PERIODIC SPLINE -- CALCULATE SLOPES
C         FOR JOIN
   55 DELN=SQRT((X(NM1)-X(N))**2+(Y(NM1)-Y(N))**2)
      DELNN=DELS1+DELN
      C1=-DELS1/DELN/DELNN
      C2=(DELS1-DELN)/DELS1/DELN
      C3=DELN/DELNN/DELS1
      SX=C1*X(NM1)+C2*X(1)+C3*X(2)
      SY=C1*Y(NM1)+C2*Y(1)+C3*Y(2)
      IF (SX.EQ.0..AND.SY.EQ.0.) SX=1
      SLPP1=ATAN2(SY,SX)
      SLPPN=SLPP1
      GO TO 10
      END
      SUBROUTINE KURV2 (T,XS,YS,N,X,Y,XP,YP,S,SIGMA)
C
C    THIS SUBROUTINE PERFORMS THE MAPPING OF POINTS IN THE
C    INTERVAL (0.,1.) ONTO A CURVE IN THE PLANE.  THE SUBROUTINE
C    KURV1 SHOULD BE CALLED EARLIER TO DETERMINE CERTAIN
C    NECESSARY PARAMETERS.  THE RESULTING CURVE HAS A PARAMETRIC
C    REPRESENTATION BOTH OF WHOSE COMPONENTS ARE SPLINES UNDER
C    TENSION AND FUNCTIONS OF THE POLYGONAL ARCLENGTH PARAMETER.
C
C    ON INPUT--
C    T = A REAL VALUE OF ABSOLUTE VALUE LESS THAN OR
C        EQUAL TO 1.  TO BE MAPPED TO A POINT ON THE CURVE.  THE
C        SIGN OF T IS IGNORED AND THE INTERVAL (0.,1.) IS MAPPED
C        ONTO THE ENTIRE CURVE.  IF T IS NEGATIVE THIS INDICATES
C        THAT THE SUBROUTINE HAS BEEN CALLED PREVIOUSLY (WITH ALL
C        OTHER INPUT VARIABLES UNALTERED) AND THAT THIS VALUE OF
C        T EXCEEDS THE PREVIOUS VALUE IN ABSOLUTE VALUE.  WITH
C        SUCH INFORMATION THE SUBROUTINE IS ABLE TO MAP THE POINT
C        MUCH MORE RAPIDLY.  THUS IF THE USER SEEKS TO MAP A
C        SEQUENCE OF POINTS ONTO THE SAME CURVE, EFFICIENCY IS
C        GAINED BY ORDERING THE VALUES INCREASING IN MAGNITUDE
C        AND SETTING THE SIGNS OF ALL BUT THE FIRST, NEGATIVE,
C    N = THE NUMBER OF POINTS WHICH WERE INTERPOLATED
C        TO DETERMINE THE CURVE,
C    X,Y = ARRAYS CONTAINING THE X- AND Y-COORDINATES
C        OF THE INTERPOLATED POINTS,
C    XP,YP = THE ARRAYS OUTPUT FROM KURV2 CONTAINING
C        CURVATURE INFORMATION,
C    S = THE POLYGONAL ARCLENGTH OF THE CURVE,
C    SIGMA = THE TENSION FACTOR (ITS SIGN IS IGNORED).
C
C    THE PARAMETERS N,X,Y,XP,UP,S, AND SIGMA SHOULD BE INPUT
C    UNALTERED FROM THE OUTPUT OF KURV1.
C
C    ON  OUTPUT--
C    XS,YS = THE X- AND Y-COORDINATES OF THE IMAGE
C        POINT ON THE CURVE.
C    T,N,X,Y,XP,YP,S, AND SIGMA ARE UNALTERED.
C
      DIMENSION X(N), Y(N), XP(N), YP(N)
C
C     *** DENORMALIZE SIGMA
      SIGMAP=ABS(SIGMA)*FLOAT(N-1)/S
C
C     *** STRETCH UNIT INTERVAL INTO ARCLENGTH DISTANCE
      TN=ABS(T*S)
C
C     *** FOR NEGATIVE T START SEARCH WHERE PREVIOUSLY TERMINATED.
C         OTHERWISE START FROM BEGINNING
      IF (T.LT.0.) GO TO 5
      I1=2
      XS=X(1)
      YS=Y(1)
      SUM=0.
      IF (T.LE.0.) RETURN
    5 CONTINUE
C
C     *** DETERMINE INTO WHICH SEGMENT TN IS MAPPED
      DO 15 I=I1,N
      DELX=X(I)-X(I-1)
      DELY=Y(I)-Y(I-1)
      DELS=SQRT(DELX*DELX+DELY*DELY)
      IF (SUM+DELS-TN) 10,20,20
   10 SUM=SUM+DELS
   15 CONTINUE
C
C     *** IF ABS(T) IS GREATER THAN 1., RETURN TERMINAL POINT ON
C         CURVE
C
      XS=X(N)
      YS=Y(N)
      RETURN
C
C     *** SET UP AND PERFORM INTERPOLATION
   20 DEL1=TN-SUM
      DEL2=DELS-DEL1
      EXPS1=EXP(SIGMAP*DEL1)
      SINHD1=.5*(EXPS1-1./EXPS1)
      EXPS=EXP(SIGMAP*DEL2)
      SINHD2=.5*(EXPS-1./EXPS)
      EXPS=EXPS1*EXPS
      SINHS=.5*(EXPS-1./EXPS)
      XS=(XP(I)*SINHD1+XP(I-1)*SINHD2)/SINHS+((X(I)-XP(I))*DEL1+(X(I-1)-
     1XP(I-1))*DEL2)/DELS
      YS=(YP(I)*SINHD1+YP(I-1)*SINHD2)/SINHS+((Y(I)-YP(I))*DEL1+(Y(I-1)-
     1YP(I-1))*DEL2)/DELS
      I1=I
      RETURN
      END
      SUBROUTINE LINER (SIG,KALCMP,F)
      COMMON /NEED/ HC,XN,NL,NR,R(20),OZP(20),OZN(8,20),RHO(8,20),MR,OC(
     14),OS(2),HCS,XNS,LS,HCLL(8),XNLL(8)
      COMMON /VVLB1/ FACTOR,DISTNC,CHRSZ,NCHR,OZLBL
      COMMON /PLTVEC/ HCT(20),OT(20),NT,OHC,HCG,PLTGRD,OXN,XNG,HCC,XNC,T
     1ICZ,DIGZ,CHRZ
      COMMON /CNTRL/ SGG,SIGMA,INFO,NPTO,TSTRT,DTIM,Z1,Z2,DCON,EHC,EXN,F
     1LST,TLST
      COMMON /INOUT/ IN,IOUT,ITAPE,IALN,IALL,INHH
      COMMON /TITL/ ITTL(36)
      COMMON /GEAR6/ RPL(20,20),RTL(20,20),NRL(20),NSL(20),NTL(20),NUL(2
     10),W(20),WW(20),OE(20),HCTP(20),XNE(20),XNEP(20),YP(20),TM(20),XNA
     2P(20),HCAP(20),HCLP(20),ITTL2(18),U(44),V(44),HCBP(20),DUM1(774)
      COMMON /SCRAT3/ WY(20)
      DIMENSION F(20), RBL(20,20), NBL(20), NTOL(20), ITTL1(36)
      INTEGER LBLTOP(6),LBLBOT(6),LBLRGT(6),LBLLFT(6)
      DATA LBLTOP,LBLRGT/12*1H /
      DATA LBLLFT/4HNOX ,4H(PPM,4H)   ,4H    ,4H    ,4H    /
      DATA LBLBOT/4HNMOC,4H (PP,4HMC) ,4H    ,4H    ,4H    /,JBL/2H  /
C
C  FIRST SET CALCOMP OPTION
C
      CHRSZ=TICZ
      IDIG1=1
      IDIG2=2
      IHY=IFIX(HC*10.+0.5)
      IHZ=IFIX(XN*1000.+0.5)
      IF (MOD(IHY,10).NE.0) IDIG1=2
      IF (MOD(IHZ,7).NE.0.OR.IHZ.LT.10) IDIG2=3
      HCC=HCC/HC
      HCX=0.
      HCM=HC/10.
      XNC=XNC/XN
      XNX=0.
      XNM=XN/7.
      XX=((10.0-(HCC*HC))/2.0)+0.3
      YY=((8.0-(XNC*XN))/2.0)+0.3
      ORGY=-.75
      IF (KALCMP.LE.0) GO TO 5
C
C  CALL PLOTS TO INITIALIZE OFFLINE PLOTTING
C
C     CALL PLOTS
      CALL PLOTS (I1,I2,14)
C
      CALL PLOT (XX,YY,-3)
    5 M=MR+1
      NLL=0
      NBLP=0
      DO 10 I=1,NL
```

```
   NUL(I)=0
   NTL(I)=0
   NTOL(I)=0
   NBL(I)=0
   NSL(I)=0
10 NRL(I)=0
   DO 11 I=1,20
   DO 11 J=1,20
11 RPL(I,J)=-9.
   OE(1)=OC(4)
   OE(2)=OS(2)
   XNE(1)=0.
   XNE(2)=XNS
   DO 15 I=1,NR
   K=NR+1-I
   OE(I+2)=OZN(MR,K)
   XNE(I+2)=HC/R(K)
   IF (XNE(I+2).GT.XN) GO TO 20
15 CONTINUE
   I=NR+1
20 I=I-1
   NE=I+2
   TOL=1.0-(0.17/(SQRT(FLOAT(NR))))
   NCR=(NR+1)/2
   CALL EDGMX (XNE,OE,NE,XMX,OZX,LX)
   NDIF=NE-LX+1
   NEW=NE
   NE=LX+1
   OE(NE)=OZX
   XNE(NE)=XMX
   CALL EDGMX (HCT,OT,NT,HMX,OZHX,LHX)
   NDIF1=NT-LHX+1
   NDIF2=NT-LHX-1
   NEW1=NT
   NT=LHX+1
   OT(NT)=OZHX
   HCT(NT)=HMX
   SX=-SIG*0.25
   IF (OZP(NL).LT.OC(2)) GO TO 25
   CALL NEWLIN (NT,OT,HCT,SX,LS,NL,1,0,HCTP,NPL,TOL,0,0,0)
   NTT=NPL
   IF (OZP(LS).GE.OC(2)) NLL=0
   IF (OZP(LS).GE.OC(2)) GO TO 45
25 SX=-SIG*10.
   IF (NR.GT.1) GO TO 30
   OT(1)=OC(1)
   HCT(1)=0.
   OT(2)=OC(2)
   HCT(2)=XN
   MR2=2
```

```
      GO TO 40                                                           AY 101
   30 DO 35 II=1,MR                                                      AY 102
      OT(II+1)=OZN(II,1)                                                 AY 103
   35 HCT(II+1)=HCLL(II)                                                 AY 104
      OT(1)=OC(1)                                                        AY 105
      HCT(1)=0.                                                          AY 106
      MR2=MR+1                                                           AY 107
   40 CALL NEWLIN (MR2,OT,HCT,SX,LS,NL,2,0,HCLP,NLL,TOL,0,0,0)           AY 108
      IF (OZP(NL).LT.OC(2)) NPL=NLL                                      AY 109
   45 NPLI=NPL+1                                                         AY 110
      IF (NPLI.GE.NL) GO TO 55                                           AY 111
      DO 50 J=NPLI,NL                                                    AY 112
   50 IF (OZP(J).LT.OE(NE)) NPL=NPL+1                                    AY 113
   55 SX=-SIG*10.                                                        AY 114
      CALL NEWLIN (NE,OE,XNE,SX,LS,NL,3,0,XNEP,NEL,TOL,0,0,0)            AY 115
      IF (OZP(LS).GE.OC(4)) GO TO 54                                     AY 116
      SX=-SIG*10.                                                        AY 117
      IF (NR.GT.1) GO TO 51                                              AY 118
      OE(1)=OC(1)                                                        AY 119
      XNE(1)=0.                                                          AY 120
      OE(2)=OC(2)                                                        AY 121
      XNE(2)=HC                                                          AY 122
      MR2=2                                                              AY 123
      GO TO 53                                                           AY 124
   51 DO 52 II=1,MR                                                      AY 125
      OE(II+1)=OZN(II,NR)                                                AY 126
   52 XNE(II+1)=XNLL(II)                                                 AY 127
      OE(1)=OC(1)                                                        AY 128
      XNE(1)=0.                                                          AY 129
      MR2=MR+1                                                           AY 130
   53 CALL NEWLIN (MR2,OE,XNE,SX,LS,NL,2,0,HCBP,NBLP,TOL,0,0,0)          AY 131
   54 CONTINUE                                                           AY 132
      IF (NDIF2.EQ.0) GO TO 70                                           AY 133
      DO 60 II=LHX,NEW1                                                  AY 134
      JJ=LHX-II+1                                                        AY 135
      IF (IABS(JJ).GT.NCR) GO TO 65                                      AY 136
      JO=II-LHX+1                                                        AY 137
      NCRJJ1=NCR+JJ-1                                                    AY 138
      OT(JO)=OZN(MR,NCRJJ1)                                              AY 139
   60 HCT(JO)=R(NCRJJ1)*XN                                               AY 140
   65 OT(NDIF1)=OZHX                                                     AY 141
      HCT(NDIF1)=HMX                                                     AY 142
      SX=-SIG*10.                                                        AY 143
      CALL NEWLIN (NDIF1,OT,HCT,SX,NEL+1,NPL,4,NEL,HCAP,II,TOL,0,0,0)    AY 144
   70 IF ((NTT+NLL).GE.NPL) GO TO 85                                     AY 145
      DO 75 II=LX,NEW                                                    AY 146
      JJ=II-LX+1                                                         AY 147
      IF (JJ.GT.NCR) GO TO 80                                            AY 148
      NCRJJ1=NCR+JJ-1                                                    AY 149
      OE(JJ)=OZN(MR,NCRJJ1)                                              AY 150
   75 XNE(JJ)=HC/R(NCRJJ1)
   80 OE(NDIF)=OZX
      XNE(NDIF)=XMX
      SX=-SIG*10.
      CALL NEWLIN (NDIF,OE,XNE,SX,NTT+1,NPL,5,NTT,XNAP,II,TOL,0,0,0)
   85 NR1=NR
      IF (OZP(LS).LT.OC(2).OR.OZP(LS).LT.OC(4)) NR1=NR-1
      NOZLST=0
      IF (OZP(LS).LT.OC(2)) IK=1
      IF (OZP(LS).GE.OC(2)) IK=0
      XOZ=AMAX1(OZHX,OZX,OC(3))
      IF (XOZ.EQ.OZHX) NOZLST=NT-2
      IF (XOZ.EQ.OC(3)) NOZLST=NCR
      IF (XOZ.EQ.OZX) NOZLST=NCR+NDIF-2
      DO 105 LL=1,NR1
      IF (OZP(LS).LT.OC(2)) I=LL+1
      IF (OZP(LS).GE.OC(2)) I=LL
      IF (NR.EQ.1) I=LL
      U(1)=OC(1)
      V(1)=0.
      DO 90 J=2,M
      J1=J-1
      U(J)=OZN(J1,I)
   90 V(J)=RHO(J-1,I)
      SX=-SIG*3.0
      IF (M.GT.2) SX=-SIG*60./(FLOAT(M-2)**2)
      CALL EDGMX (V,U,M,HHMX,OZMMX,MM1)
      MM=MM1+1
      IF (MM.GE.M) GO TO 100
      U(MM)=OZMMX
      V(MM)=HHMX
      MDIF=M-MM1
      DO 95 J=1,MDIF
      MJ=M-J
      W(J)=OZN(MJ,I)
   95 WW(J)=RHO(MJ,I)
      W(MDIF+1)=OZMMX
      WW(MDIF+1)=HHMX
      MDIF=MDIF+1
      IF ((LL-IK).LE.NOZLST) CALL NEWLIN (MDIF,W,WW,SX,LS,NL,6,0,RTL(1,I
     1),IJ,TOL,NUL,NTL,I)
      IF ((LL-IK).GT.NOZLST) CALL NEWLIN (MDIF,W,WW,SX,LS,NL,6,0,RBL(1,I
     1),IJ,TOL,NTOL,NBL,I)
      SX=-SIG*3.0
      IF (MM.GT.2) SX=-SIG*60./(FLOAT(MM-2)**2)
  100 CALL NEWLIN (MM,U,V,SX,LS,NL,7,0,RPL(1,I),II,TOL,NRL,NSL,I)
  105 CONTINUE
      CALL ISOPLT (HCTP,XN,1)
      SX=SIGMA*30./FLOAT(NR)
      NTT2=NTT+NLL
      IF (NTT.NE.0.AND.NLL.NE.0) NTT2=NTT
      NW=0
      DO 175 I=LS,NPL
      K=1
      IF (I.LE.NTT2) GO TO 110
      U(1)=HC
      INTT=I-NTT
      V(1)=XNAP(INTT)
      GO TO 120
  110 IF (OZP(LS).GT.OC(2)) GO TO 115
      IF (I.GT.NLL) GO TO 115
      U(1)=0.
      V(1)=HCLP(I)
      GO TO 120
  115 U(1)=HCTP(I)
      V(1)=XN
  120 NT=NUL(I)
      NE=NTL(I)
      IF (NE.EQ.0) GO TO 130
      DO 125 JI=NE,NT
      J=NT-JI+1
      K=K+1
      V(K)=RTL(I,J)/F(J)
  125 U(K)=V(K)*R(J)
  130 NT=NRL(I)
      NE=NSL(I)
      IF (NE.EQ.0) GO TO 140
      DO 135 J=NE,NT
      K=K+1
      V(K)=RPL(I,J)/F(J)
  135 U(K)=V(K)*R(J)
  140 NT=NTOL(I)
      NE=NBL(I)
      IF (NE.EQ.0) GO TO 150
      DO 145 JI=NE,NT
      J=NT-JI+1
      K=K+1
      V(K)=RBL(I,J)/F(J)
  145 U(K)=V(K)*R(J)
  150 IF (OZP(LS).GT.OC(4)) GO TO 151
      IF (I.GT.NBLP) GO TO 151
      K=K+1
      U(K)=HCBP(I)
      V(K)=0.
      GO TO 160
  151 IF (I.GT.NEL) GO TO 155
      K=K+1
      U(K)=HC
      V(K)=XNEP(I)
      GO TO 160
  155 IF (NDIF2.EQ.0) GO TO 160
      K=K+1
      INEL=I-NEL
      U(K)=HCAP(INEL)
      V(K)=XN
  160 U(K+1)=0.
      U(K+2)=1./HCC
      V(K+1)=0.
      V(K+2)=1./XNC
      IF (K.LE.2) GO TO 175
      OZLBL=OZP(I)
      NW=NW+1
      WY(NW)=OZP(I)
      NCHR=4
      NCNT=0
  165 VAL=OZLBL*(10.**NCNT)
      IF (VAL.GT.0.01) GO TO 170
      NCNT=NCNT+1
      GO TO 165
  170 NCHR=NCHR+NCNT
      REMB=OZLBL-FLOAT(IFIX(OZLBL*(10.**(NCNT+2))+0.1))/(10.**(NCNT+2))
      IF (REMB.GE.(0.001/(10.**NCNT))) NCHR=NCHR+1
      DO 171 IJ=1,K
      IF (U(IJ).GE.0..AND.V(IJ).GE.0.) GO TO 171
      NE=NSL(I)
      KN=NE+IJ-2
      XNE(1)=OC(1)
      WW(1)=0.
      DO 172 JJ=2,M
      XNE(JJ)=OZN(JJ-1,KN)
  172 WW(JJ)=RHO(JJ-1,KN)
      SSX=-50.
      IT=1
      CALL CURV1 (M,XNE,WW,SP1,SP2,YP,TM,SSX)
      U(IJ)=CURV2 (OZP(I),M,XNE,WW,YP,SSX,IT)
      V(IJ)=U(IJ)/F(KN)
      U(IJ)=V(IJ)*R(KN)
  171 CONTINUE
      CALL CURVE (U,V,K,1,KALCMP,0,0,SX)
  175 CONTINUE
      IF (KALCMP.LE.0) GO TO 210
      CALL FRAME (0.,0.,0.,HC,HCC,HCX,HCM,IDIG1,0.,XN,XNC,XNX,XNM,IDIG2,
     1LBLBOT,22,LBLLFT,22,LBLTOP,1,LBLRGT,1)
      NCNT=0
      DO 180 I=1,36
      IF (ITTL(I).NE.JBL) GO TO 185
      NCNT=NCNT+1
  180 CONTINUE
  185 NLST=36-NCNT
      DO 190 I=1,NLST
```

```
        INCNT=I+NCNT
  190 ITTL1(I)=ITTL(INCNT)
      NCNT1=36
      DO 195 I=1,36
      II=37-I
      IF (ITTL1(II).NE.JBL) GO TO 200
      NCNT1=NCNT1-1
  195 CONTINUE
  200 NCNT1=NCNT1-NCNT
      ORGX=((HCC*HC)-(FLOAT(NCNT1)*2.*CHRZ))/2.0
      DO 205 I=1,NCNT1
      CALL SYMBOL (ORGX,ORGY,CHRZ,ITTL1(I),0.,2)
      ORGX=ORGX+2.0*CHRZ
  205 CONTINUE
      CALL PLOT (10.,2.,999)
  210 HCS=FLOAT(NW)
      XNS=FLOAT(NLL)
C 155 CALL ISOPLT
      CALL ISOPLT (HC,XN,3)
      RETURN
      END
      SUBROUTINE NEWLIN (N,OT,HCT,SX,NS,NE,NL,NR,XNL,NPL,TOL,NUL,NTL,II)
      COMMON /NEED/ HC,XN,NN,NB,R(20),OZP(20),OZN(8,20),RHO(8,20),M,OC(4
     1 ),OS(2),HCS,XNS,LS,HCLL(8),XNLL(8)
      DIMENSION XNL(20), OT(20), HCT(20), YP(20), TM(20), NUL(20), NTL(2
     10)
      IT=1
      ISAV=0
      IF (OT(N-1).LT.TOL*OT(N)) GO TO 10
      IF (N.LE.2) GO TO 10
      DO 5 I=NS,NE
      J=NE-I+NS
      IF (OZP(J).LE.OT(N).AND.OZP(J).GE.OT(N-1)) GO TO 10
    5 CONTINUE
      N=N-1
   10 CALL CURV1 (N,OT,HCT,SP1,SP2,YP,TM,SX)
      IF (NL.LT.6) GO TO 12
      IF (IT.GT.0) GO TO 12
      DO 11 I=NS,NE
      NUL(I)=0
      NTL(I)=0
   11 CONTINUE
      IT=1
   12 DO 20 I=NS,NE
      IF (OZP(I).GT.OT(N)) GO TO 25
      IF (OZP(I).LT.OT(1).AND.NL.EQ.6) GO TO 20
      IF (OZP(I).LT.OT(1).AND.NL.GT.6) GO TO 25
      IF (NL.LT.6) GO TO 15
      IF (IT.GT.0) NUL(I)=NUL(I)+1
      IF (NUL(I).EQ.1) NTL(I)=II
      IF (NUL(I).EQ.1) NUL(I)=II
   15 INR=I-NR
      XNL(INR)=CURV2(OZP(I),N,OT,HCT,YP,SX,IT)
      IF (IT.GT.0) GO TO 20
      ISAV=I
      SX=SX*10.
      SX=AMAX1(-50.,SX)
      GO TO 10
   20 IT=2
      I=NE+1
   25 NPL=I-1
      RETURN
      END
      SUBROUTINE VVLBLF (X2,Y2,IENTRY)
C
C     *** SETS A LINE LABEL INTO A VECTOR PLOT PROVIDING THAT
C         A CALL TO SUBROUTINE PLTLBL HAS PRESET THE NECESSARY
C         PARAMETERS IN /VVLB1/
C             GW LUNDBERG/SAI  DEC !77
C
C     X2,Y2    THE TERMINAL POINT OF THE CURRENT VECTOR
C              IN INCHES FROM PRESENT PLOT ORIGIN
C
C     *** NOTES --
C         (1) THERE ARE THREE ENTRY POINTS -- VVLBLF SETS UP THE
C             PARAMETERS FOR VVLBLC WHICH ACTUALLY DOES THE LABELING.
C             VVLBLL CLEANS UP IN CASE THERE WAS NOT ENOUGH
C             ROOM FOR THE LAST LABEL
C         (2) THE LABELS ARE SEPERATED BY DIST INCHES EXCEPT FOR
C             THE FIRST LABEL WHICH STARTS FACT*DIST INCHES FROM
C             THE BEGINNING OF THE VECTOR PLOT -- THIS PROVIDES FOR
C             STAGGERED LABELS.
C
      DIMENSION XSV(20), YSV(20)
C
C     *** DIST IS THE DISTANCE IN INCHES BETWEEN LABELS.  FACT
C         IS THE FACTOR (0-1) OF DIST TO USE FOR THE FIRST LABEL.
C         CHRSZ IS THE SIZE OF THE LABEL CHARACTERS IN INCHES.
C         NCHR IS THE NUMBER OF CHARACTERS (0-10), AND LABEL
C         IS THE A-FORMATED TEXT OF THE LABEL
      COMMON /VVLB1/ FACT,DIST,CHRSZ,NCHR,OZL
      DATA MXSV/20/
C
C     EMULATE MULTIPLE ENTRY WITH COMPUTED GO TO
      GO TO (1000,2000,3000),IENTRY
      STOP
C
C     MAIN ENTRY POINT
 1000 CONTINUE
C
C     *** MOVE THE PEN TO THE FIRST POINT
      CALL PLOT (X2,Y2,3)
C
C     *** IF THERE ARE TO BE NO LABELS -- JUST RETURN
      IF (NCHR.EQ.0) RETURN
C
C     *** SET UP THE OFFSET NECESSARY TO CENTER THE LABEL AND
C         THE DISTANCE REQUIRED BY THE LABEL
      OFF=CHRSZ/2.
      SZLBL=FLOAT(NCHR)*CHRSZ+2.*OFF-0.3*CHRSZ
C
C     *** INITALIZE THE ACCUMULATED LENGTH OF THE VECTORS, THE
C         LENGTH REQUIRED BEFORE FIRST LABEL, AND THE NUMBER
```

```
C         OF SAVED POINTS (VECTORS) THAT MAY HAVE BEEN PREEMPTED
C         BY THE LABEL
      TOTSZ=0.
      SKPSZ=FACT*DIST
      NSV=0
C
C     *** REMEMBER THE STARTING LOCATION OF FIRST VECTOR
      X1=X2
      Y1=Y2
C
      RETURN
C
C***************************************************************
C                     ENTRY VVLBLC
C***************************************************************
C
 2000 CONTINUE
C
C     *** IF THERE ARE TO BE NO LABELS -- PLOT THE VECTOR AND RETURN
      IF (NCHR.GT.0) GO TO 5
      CALL PLOT (X2,Y2,2)
      RETURN
C
C     *** IF SEEKING ROOM FOR THE LABEL -- SKIP FOLLOWING
    5 IF (NSV.GT.0) GO TO 15
C
C     *** CALCULATE THIS VECTOR LENGTH AND ADD TO THE ACCUMULATED
C         LENGTH.  IF A LABEL IS TO START IN THIS VECTOR, SKIP TO
C         120, ELSE PLOT THE VECTOR AND RETURN
      VECSZ=SQRT((X2-X1)**2+(Y2-Y1)**2)
      TOTSZ=TOTSZ+VECSZ
      IF (TOTSZ.GT.SKPSZ) GO TO 10
      CALL PLOT (X2,Y2,2)
      X1=X2
      Y1=Y2
      RETURN
C
C     *** ITS TIME FOR A LABEL -- LOCATE START
   10 RATIO=(VECSZ-TOTSZ+SKPSZ)/VECSZ
      X1L=X1+RATIO*(X2-X1)
      Y1L=Y1+RATIO*(Y2-Y1)
C
C     *** PLOT SUBVECTOR AND REMEMBER THE END POINT
      CALL PLOT (X1L,Y1L,2)
      X1=X1L
      Y1=Y1L
C
C     *** FIND OUT IF THERE IS ENOUGH ROOM LEFT IN THIS VECTOR
C         FOR THE LABEL -- IF THERE ISNT, SAVE (X2,Y2) AND RETURN
   15 HAVSZ=SQRT((X2-X1L)**2+(Y2-Y1L)**2)
```

```
      IF (HAVSZ.GE.SZLBL) GO TO 20
      NSV=NSV+1
C
C     *** CHECK FOR OVERFLOW
      IF (NSV.GT.MXSV) STOP
      XSV(NSV)=X2
      YSV(NSV)=Y2
      X1=X2
      Y1=Y2
      RETURN
C
C     *** CALCULATE THE END OF THE LABEL
C         IM SURE THERE IS AN EASIER WAY TO DO THIS, BUT IT
C         ESCAPES ME
   20 A=(X2-X1)**2+(Y2-Y1)**2
      B=-2.0*((X1L-X1)*(X2-X1)+(Y1L-Y1)*(Y2-Y1))
      C=(X1L-X1)**2+(Y1L-Y1)**2-SZLBL*SZLBL
C
      SQRTD=SQRT(B*B-4.0*A*C)
      T1=(-B+SQRTD)/(2.0*A)
      T2=(-B-SQRTD)/(2.0*A)
C
C     *** PICK THE MINIMUM T BETWEEN 0-1 (MUST BE ONE)
      IF (T1.LT.0.) T1=1.
      IF (T2.LT.0.) T2=1.
      RATIO=AMIN1(T1,T2)
C
C     *** SET LABEL END POINT
      X2L=X1+RATIO*(X2-X1)
      Y2L=Y1+RATIO*(Y2-Y1)
C
C     *** CALCULATE LABEL ANGLE
      DX=X2L-X1L
      DY=Y2L-Y1L
      ANG=0.
      IF (DY.NE.0.) ANG=ATAN2(DY,DX)
C
      XL=X1L
      YL=Y1L
      COSA=COS(ANG)
      SINA=SIN(ANG)
C
C     *** REVERSE EVERYTHING IF ANGLE IN QUADRANIS 2 OR 3
      IF (DX.GE.0.) GO TO 25
      XL=X2L
      YL=Y2L
      COSA=-COSA
      SINA=-SINA
      IF (DY.GE.0.) ANG=ANG-3.1415926536
      IF (DY.LT.0.) ANG=ANG+3.1415926536
   25 ANGD=ANG*180./3.1415926536
C
C     *** LOCATE AND PLOT LABEL
      XL=XL+OFF*COSA+OFF*SINA
      YL=YL+OFF*SINA-OFF*COSA
      IDG=NCHR-2
      CALL NUMBER (XL,YL,CHRSZ,OZL,ANGD,IDG)
C
C     *** FINISH OFF THIS SEQMENT BY MEANS OF A PSUEDO REENTRY
      TOTSZ=0.
      SKPSZ=DIST
      NSV=0
      X1=X2L
      Y1=Y2L
      CALL PLOT (X1,Y1,3)
      GO TO 5
C
C*****************************************************************
C                    ENTRY VVLBLL
C*****************************************************************
C
 3000 CONTINUE
C
C     *** PLOT THE SAVED VECTORS IF ANY
      IF (NSV.EQ.0) RETURN
      DO 30 I=1,NSV
      CALL PLOT (XSV(I),YSV(I),2)
   30 CONTINUE
      NSV=0
      RETURN
C
      END
```